

## 3.4 Noise and Vibration

### 3.4.1 Introduction

This section describes the regulatory setting, affected environment, impacts, and mitigation measures for noise and vibration resulting from the project. Noise and vibration are key elements of the environmental impact analysis because their increases over existing levels near the California High-Speed Train (HST) project are a significant impact.

The HST Program EIR/EIS documents identified project engineering and design elements to reduce or avoid potential noise and vibration impacts. During the period between the scoping meetings and preparation of this Project EIR/EIS, the alternative analysis process identified those alignments and design options that would avoid or minimize potential impacts to noise- and vibration-sensitive receivers. One important noise and vibration design choice was for the HST System to use distributed power electric motor unit (EMU) trainsets that will have lower noise emissions than locomotive-hauled electric trainsets according to the Federal Railroad Administration (FRA) noise and vibration guidance manual (FRA 2005).

The noise and vibration limits chosen for construction and operation of the HST System satisfy the federal guidelines of the FRA and Federal Transit Administration (FTA) for train and HST facility operations and Federal Highway Administration (FHWA) as defined for California application by the California Department of Transportation (Caltrans) for traffic noise.

### 3.4.2 Laws, Regulations, and Orders

Noise and vibration impacts from major transportation projects are important federal and state environmental concerns and review requirements. In order to aid in compliance with environmental regulations and guidelines related to noise and vibration, FRA and FTA have developed guidance for assessing noise and vibration impacts from major rail projects like HST. FRA and FTA guidance is intended to satisfy environmental review requirements and assist project sponsors in addressing predicted construction and operation noise and vibration during the design process.

#### 3.4.2.1 Federal

##### **Federal Noise Emission Compliance Regulation**

FRA has a regulation governing compliance of noise emissions from interstate railroads. The FRA's Railroad Noise Emission Compliance Regulation (49 CFR Part 210) prescribes compliance requirements for enforcing railroad noise emission standards adopted by EPA (40 CFR Part 201).

##### **FHWA Procedures for Abatement of Highway Traffic Noise and Construction Noise, as provided in 23 CFR Subchapter H, Section 772**

The criteria for highway noise impacts (relevant to the extent HST causes changes in traffic patterns) are included in the FHWA Procedures for Abatement of Highway Traffic Noise and Construction Noise (23 CFR Part 772).

#### 3.4.2.2 State

##### **California Noise Control Act**

At the state level, the California Noise Control Act, enacted in 1973 (Health and Safety Code Section 46010 et seq.), requires the Office of Noise Control in the Department of Health Services to provide assistance to local communities developing local noise control programs and works

with the Office of Planning and Research to provide guidance for preparing required noise elements in city and county general plans, pursuant to Government Code Section 65302(f). In preparing the noise element, a city or county must identify local noise sources, and analyze and quantify, to the extent practicable, current and projected noise levels for various sources, including highways and freeways, passenger and freight railroad operations, ground rapid transit systems, commercial, general, and military aviation and airport operations, and other ground stationary noise sources. These would include HST alignments. The California Noise Control Act stipulates the mapping of noise-level contours for these sources, using community noise metrics appropriate for environmental impact assessment as defined in Section 3.4.3. Cities and counties use these as guides to making land use decisions to minimize the community residents' exposure to excessive noise.

### 3.4.2.3 Regional and Local

Counties and cities in California prepare general plans with noise policies and ordinances (outlined above in the discussion of state regulations). These noise elements often incorporate specific allowable noise levels to achieve a quality environment. Many noise elements reviewed for cities and counties in the Fresno to Bakersfield Section include restrictions on construction hours; none have noise level limits on construction. Where airports exist, the general plans include a section on airport land use compatibility plans with respect to noise so that new noise-sensitive uses are not located near or do not encroach on the area. The general plans do not address ground-borne vibration. The *Fresno to Bakersfield Section: Noise and Vibration Technical Report* (Authority and FRA 2012) summarizes the noise-related information from the city and county general plans for the Fresno to Bakersfield Section. These local plans and policies were identified and considered in the preparation of this analysis.

### 3.4.3 Methods for Evaluating Impacts

The analysis of noise and vibration impacts used design information for the proposed alignment and field noise and vibration measurements. The FRA (2005) guidance manual, *High-Speed Ground Transportation Noise and Vibration Impact Assessment*, was the primary source of guidance for analyzing HST noise and vibration impacts and mitigation, which was supplemented by FTA (2006) guidance, *Transit Noise and Vibration Impact Assessment*, for non-HST noise. The FRA manual provides guidelines for establishing the extent of the study area to be used for the noise and vibration impact analyses. It also provides guidance for identifying noise-sensitive locations where increased annoyance (the startle effect) can occur from HST pass-bys. The methodology followed by the noise and vibration analysts is described below.

- For HST noise sources, analysts used the FRA guidance manual (FRA 2005, Chapter 5 – Detailed Noise Analysis, Chapter 9 – Detailed Vibration Assessment). Analysts also used the FTA guidance manual for the detailed vibration impact analysis (FTA 2006, Chapter 11 – Detailed Vibration Analysis).
- For non-HST noise sources, such as stations, maintenance facilities and construction, analysts followed the methods described in the FTA guidance manual (FTA 2006).
- For traffic noise sources, analysts followed the methods described in the *FHWA Highway Traffic Noise: Analysis and Abatement Guidance* (FHWA 2010).

The following thresholds were used for the impact analyses:

- FRA Severe Noise Impact Criteria for HST Operations.
- FRA Moderate Noise Impact Criteria for HST Operations.
- FRA Increased Annoyance from Rapid Onset Rates of HST Pass-bys.
- FRA Interim Criteria for Noise Impacts on Animals.

- FRA Vibration Impact Criteria for HST Operations
- FTA Detailed Vibration Impact Criteria.
- Caltrans Noise Abatement Criteria for Traffic.
- FTA Noise Impact Criteria for Ancillary and Non-HST Noise Sources, such as stations and maintenance facilities.

Additional details regarding evaluation methods are provided in the following sections and in the *Fresno to Bakersfield Section: Noise and Vibration Technical Report* (Authority and FRA 2012).

### 3.4.3.1 What is Noise?

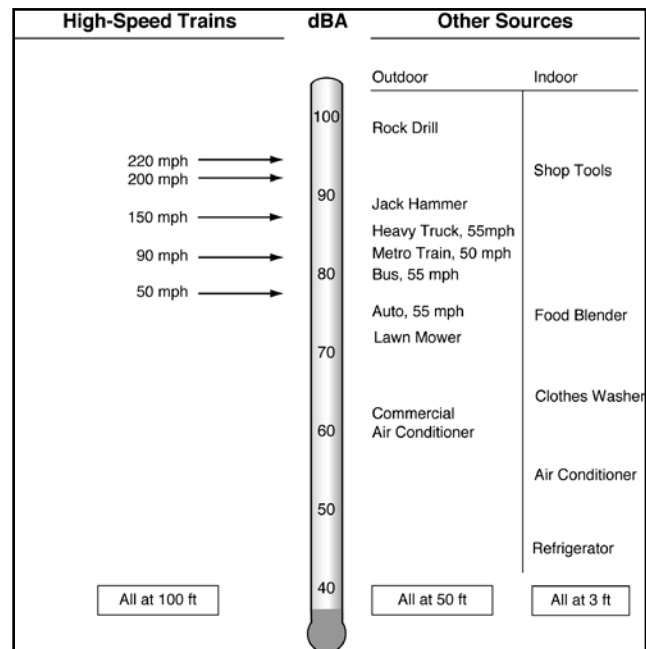
Noise from an HST system is expressed in terms of a “source-path-receiver” framework. The “source” generates noise levels that depend on the type of source (e.g., a high-speed train) and its operating characteristics (e.g., speed). The “receiver” is the noise-sensitive land use (e.g., residence, hospital, or school) exposed to noise from the source. In between the source and the receiver is the “path” where the noise is reduced by distance, intervening buildings, and topography. Environmental noise impacts are assessed at the receiver. Noise criteria are established for the various types of receivers because not all receivers have the same noise-sensitivity.

#### Measuring Noise Levels

Noise is unwanted sound. Sound is measured in terms of sound pressure level and is usually expressed in decibels (dB). The human ear is less sensitive to higher and lower frequencies than it is to mid-range frequencies. All noise ordinances, and this noise analysis, use the A-weighting system, which measures what humans hear in a more meaningful way because it reduces the sound levels of higher- and lower-frequency sounds—similar to what humans hear. Measurements taken with this A-weighted filter are referred to as dBA readings.

Analysts use three primary noise measurement descriptors to assess noise impacts from traffic and transit projects. They are the equivalent sound level ( $L_{eq}$ ), the day-night sound level ( $L_{dn}$ ), and the sound exposure level (SEL):

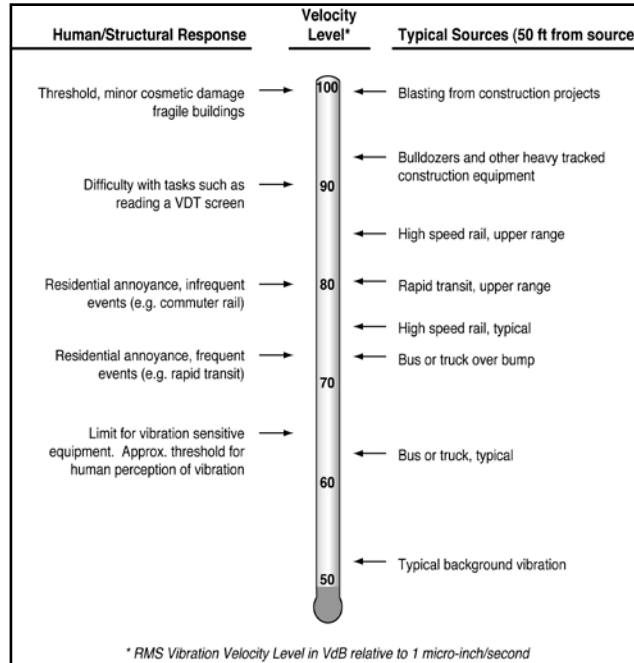
- $L_{eq}$ : The level of a constant sound for a specified period of time that has the same sound energy as an actual fluctuating noise over the same period of time. The peak-hour  $L_{eq}$  is used for all traffic and rail noise analyses at locations with daytime use, such as schools and libraries.
- $L_{dn}$ : The  $L_{eq}$  over a 24-hour period, with 10 dB added to nighttime sound levels (between 10 p.m. and 7 a.m.) as a penalty to account for the greater sensitivity and lower background sound levels during this time. The  $L_{dn}$  is the primary noise-level descriptor for rail noise in residential land uses. Figure 3.4-1 shows typical  $L_{dn}$  noise levels. The *Fresno to Bakersfield Section: Noise and Vibration Technical Report* provides details regarding noise and noise descriptors.
- **SEL**: The sound exposure level (SEL) during a single noise event is the primary descriptor of a single noise event, and is used to describe noise from a HST passing



**Figure 3.4-1**  
 Typical  $L_{max}$  noise levels

a location along the track. SEL is an intermediate value in the calculation of both  $L_{eq}$  and  $L_{dn}$ . It represents a receiver's cumulative noise exposure from an event (train pass-by), and represents the total A-weighted sound during the event normalized to a 1-second interval.

In addition to the  $L_{eq}$ ,  $L_{dn}$ , and SEL, there is another descriptor used to describe noise. The loudest 1 second of noise over a measurement period, or maximum A-weighted sound pressure level ( $L_{max}$ ) is used in many local and state ordinances for noise coming from private land uses and for construction impact evaluations. Figure 3.4-1 shows typical maximum A-weighted sound pressure levels for HSTs and other sources.



**Figure 3.4-2**

Typical levels of ground-borne vibration  
 Source: FRA (2005)

**3.4.3.2 What Is Vibration?**

Vibration from an HST system is also expressed in terms of a "source-path-receiver" framework. The "source" is the train rolling on the tracks, which generates vibration energy transmitted through the supporting structure under the tracks and into the ground. Once the vibration gets into the ground, it propagates through the various soil and rock strata—the "path"—to the foundations of nearby buildings, the "receivers." Ground-borne vibrations generally reduce in levels with distance depending on the local geological conditions. A "receiver" is a vibration-sensitive building (e.g., residence, hospital, or school) where the vibrations may cause perceptible shaking of the floors, walls, and ceilings and a rumbling sound inside rooms. Not all receivers have the same vibration-sensitivity. Consequently, criteria are established for the various types of receivers. Ground-borne vibration can be described in terms of displacement, velocity, or acceleration for evaluating impacts from transit projects. Ground-borne noise occurs as a perceptible rumble and is caused by the noise radiated from the vibration of room surfaces. Vibration above certain levels can damage buildings, disrupt sensitive operations, and cause annoyance to humans within buildings.

Figure 3.4-2 illustrates typical ground-borne vibration velocity levels for common sources and thresholds for human and structural response to ground-borne vibration. As shown, the range of interest is from approximately 50 to 100 vibration velocity level (VdB) (i.e., from imperceptible background vibration to the threshold of damage). Although the threshold of human perception to vibration is approximately 65 VdB, annoyance does not usually occur unless the vibration exceeds 70 VdB.

**3.4.3.3 Impact Assessment Guidance**

For the impact assessment for noise and vibration, two different guidance documents are used. For construction impacts, the FTA (2006) assessment document is used to assess impacts; and while for project impacts the FRA (2005) assessment document is used. The reason for using both documents is that the FTA (2006) guidance is a more recent and complete addition to the measurement of noise and vibration impacts; however, it does not specifically discuss impacts from the operation of a HST while the FRA guidance does. Accordingly, for construction impacts

that do not differ by transportation type the more recent and complete FTA (2006) guidance is used, while for project operations the FRA (2005) guidance is used.

The noise- and vibration-sensitive receivers include residential dwellings, schools, churches, hospitals, parks, and historic properties. The noise and vibration impact analysis is based on screening distances from these sensitive receivers. The impact assessment lists the noise and vibration screening distances for various land uses for both HST operations and construction. All noise- and vibration-sensitive receivers that fall inside these screening distances will be identified, and the future projected noise with the project will be estimated based on the noise impact analysis methodology that has been developed for this project. The implications of these noise and vibration levels to indoor and outdoor school activities will be described in subsequent sections of the analysis.

**Construction Thresholds**

Construction activities associated with a large transportation project often generate noise and vibration complaints even though they take place over a limited period. For the impact assessment from construction noise and vibration, the threshold is the exposure of noise- and vibration-sensitive receivers to construction noise or vibration at levels exceeding standards established by FTA and established thresholds for architectural and structural building damage (FTA 2006).

**Construction Noise**

Table 3.4-1 shows the FTA noise assessment criteria for construction. The last column applies to construction activities that extend over 30 days near any given receiver.  $L_{dn}$  is used to assess impacts in residential areas and 24-hr  $L_{eq}$  is used in commercial and industrial areas. The 8-hr  $L_{eq}$  and the 30-day average  $L_{dn}$  noise exposure from construction noise calculations use the noise emission levels of the construction equipment, their location, and operating hours. The construction noise limits are normally assessed at the noise-sensitive receiver property line edge.

**Construction Vibration**

The FTA guidance manual (FTA 2006) provides the basis for the construction vibration assessment.

FTA provides construction vibration criteria designed primarily to prevent building damage, and to assess whether vibration might interfere with vibration-sensitive building activities or temporarily annoy building occupants during the construction period. The FTA criteria include two ways to express vibration levels: (1) root-mean-square (RMS) vibration velocity level (VdB) for annoyance and activity interference; and (2) peak particle velocity (PPV), which is the maximum instantaneous peak of a vibration signal used for assessments of damage potential.

**Measuring Vibration Levels**

Ground-borne noise occurs as a perceptible rumble and is caused by the noise radiated from the vibration of room surfaces. Vibration above certain levels can damage buildings, disrupt sensitive operations, and cause annoyance to humans within buildings.

The response of humans, buildings, and equipment to vibration is most accurately described using velocity or acceleration. In this analysis, vibration velocity is expressed in terms of VdB as the primary measurement to evaluate the effects of vibration. The frequency distribution of vibration energy is important for detailed impact analyses. Analysts break the frequency range into segments called 1/3-octave bands for detailed analyses.

**Table 3.4-1**  
 FTA Construction Noise Assessment Criteria

| Land Use    | 8-hour $L_{eq}$ , dBA |       | Noise Exposure, $L_{dn}$ , dBA |
|-------------|-----------------------|-------|--------------------------------|
|             | Day                   | Night | 30-day Average                 |
| Residential | 80                    | 70    | 75 <sup>a</sup>                |
| Commercial  | 85                    | 85    | 80 <sup>b</sup>                |
| Industrial  | 90                    | 90    | 85 <sup>b</sup>                |

Source: FTA 2006.

<sup>a</sup> In urban areas with very high ambient noise levels ( $L_{dn}$  greater than 65 dB),  $L_{dn}$  from construction operations should not exceed existing ambient + 10 dB.

<sup>b</sup> 24-hour  $L_{eq}$ , not  $L_{dn}$

Acronyms:  
 dBA A-weighted decibel(s)  
 $L_{dn}$  day-night sound level  
 $L_{eq}$  equivalent sound level

To avoid temporary annoyance to building occupants during construction or construction interference with vibration-sensitive equipment inside special-use buildings, such as a magnetic resonance imaging (MRI) machine, FTA recommends using the long-term operational vibration criteria provided below in the Vibration Criteria – HST Operations section.

Table 3.4-2 shows the FTA building damage criteria for construction activity; the table lists PPV limits for four building categories. These limits are used to estimate potential problems that should be addressed during final design. See the *Fresno to Bakersfield Section: Noise and Vibration Technical Report* (Authority and FRA 2012) for a description of the metrics.

**Table 3.4-2**  
 Construction Vibration Damage Criteria

| Building Category                                       | PPV (inch/sec) | Approximate $L_v$ <sup>a</sup> |
|---|----------------|--------------------------------|
| I. Reinforced concrete, steel, or timber (no plaster)   | 0.5            | 102                            |
| II. Engineered concrete and masonry (no plaster)        | 0.3            | 98                             |
| III. Non-engineered timber and masonry buildings        | 0.2            | 94                             |
| IV. Buildings extremely susceptible to vibration damage | 0.12           | 90                             |

Source: FTA 2006.

<sup>a</sup> RMS vibration velocity level in VdB relative to 1 micro-inch/second.

Acronym:  
 PPV peak particle velocity

**Project Thresholds**

***Noise Criteria – HST Operations***

The descriptors and criteria for assessing noise impact vary according to land use categories adjacent to the track. For land uses where people live and sleep (e.g., residential neighborhoods,

hospitals, and hotels), the  $L_{dn}$  is the assessment parameter. For other land-use types where there are noise-sensitive uses (e.g., outdoor concert areas, schools, and libraries), the  $L_{eq}[h]$  for an hour of noise sensitivity that coincides with train activity is the assessment parameter. Table 3.4-3 summarizes the three land use categories.

Specific types of impacts use other noise descriptors. For disturbance of wildlife and domestic animals, the noise exposure from an individual train passage, called the SEL, is determined. The potential for startle effects for people near the HST is addressed in terms of a combination of train speed and distance from the track.

**Table 3.4-3**  
 FRA Noise-Sensitive Land Uses

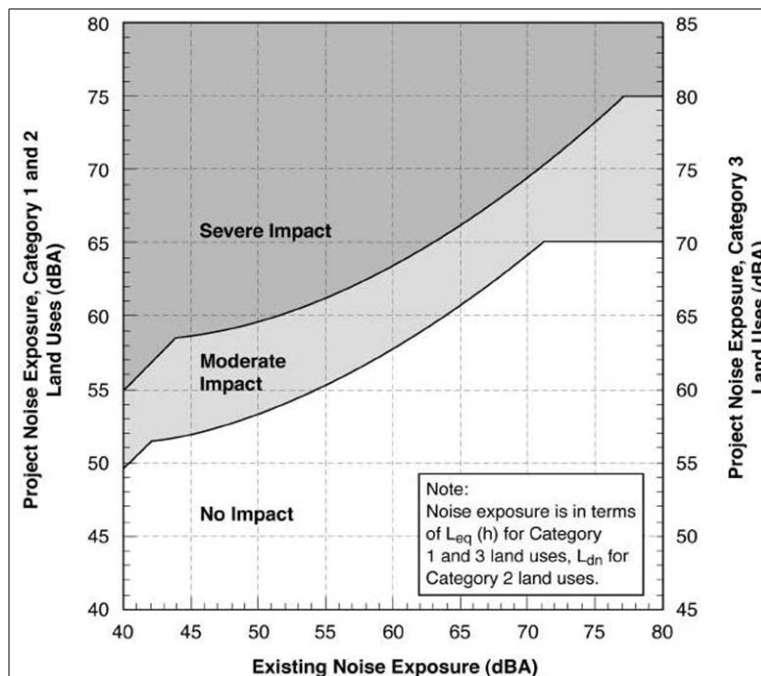
| Land Use Category | Noise Metric dBA <sup>a</sup>    | Land Use Category   |
|-------------------|----------------------------------|---|
| 1                 | Outdoor $L_{eq}(h)$ <sup>b</sup> | Tracts of land where quiet is an essential element in their intended purpose. This category includes lands set aside for serenity and quiet, such as outdoor amphitheaters, concert pavilions, and National Historic Landmarks with significant outdoor use.  |
| 2                 | Outdoor $L_{dn}$                 | Residences and buildings where people normally sleep. This category includes homes and hospitals, where nighttime sensitivity to noise is of utmost importance.   |
| 3                 | Outdoor $L_{eq}(h)$ <sup>b</sup> | Institutional land uses with primarily daytime and evening use. This category includes schools, libraries, and churches, where it is important to avoid interference with such activities as speech, meditation, and concentration. Buildings with interior spaces where quiet is important, such as medical offices, conference rooms, recording studios, concert halls fall into this category, as well as places for meditation or study associated with cemeteries, monuments, and museums. Certain historical sites, parks, and recreational facilities are also included. |

Source: FRA 2005.

Notes:  
<sup>a</sup> Onset-rate adjusted sound levels ( $L_{eq}$  and  $L_{dn}$ ) are to be used where applicable.  
<sup>b</sup>  $L_{eq}$  for the noisiest hour of transit-related activity during hours of noise sensitivity.

Acronyms:  
 dBA A-weighted decibel(s)  
 $L_{eq}$  equivalent sound level, dBA

The noise impact criteria used by the FRA and FTA are ambient-based; the increase in future noise (future noise levels with the project compared to existing noise levels) is assessed rather than the noise caused by each passing train. The criteria specify a comparison of future project noise with existing levels because comparison with an existing condition is more accurate (FRA 2005). Figure 3.4-3 shows the FRA noise impact criteria for human annoyance. Depending on the magnitude of the cumulative noise increases, FTA and FRA categorize impacts as (1) no impact; (2) moderate impact; or (3) severe impact. Severe impact is where a significant percentage of people would be highly annoyed by the project's noise. Moderate impact is where the change in cumulative noise level would be noticeable to most people, but may not be sufficient to generate strong, adverse reactions.



**Figure 3.4-3**  
 FRA noise impact criteria  
 Source: FRA (2005)

**Noise Criteria – Traffic**

The criteria for highway noise impacts (relevant to the extent HST causes changes in traffic patterns) are from the FHWA Procedures for Abatement of Highway Traffic Noise and Construction Noise, as provided in 23 CFR Subchapter H, Section 772. Table 3.4-4 summarizes the traffic noise abatement criteria. A noise impact occurs if projected noise levels approach the levels for specific land use categories listed in Table 3.4-4, or substantially exceed existing noise levels, as defined by Caltrans. In accordance with the regulations, a traffic noise analysis is required only for projects that include: (1) construction of a new highway; or (2) reconstruction of an existing highway with a substantial change in the horizontal alignment or vertical profile or an increase in the number of through traffic lanes. If impacts are identified, noise abatement must be considered. In addition, FHWA guidance regarding the physical alteration of an existing highway states “changes in the horizontal alignment that reduce the distance between the source and the receiver by half or more result in a Type 1 project” (FHWA 2010). A Type 1 project is defined in 23 CFR 772 as a proposed federal or federal-aid highway project for the construction of a highway at 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. FHWA requires identifying highway traffic noise impacts and examining potential abatement measures for all Type 1 projects receiving federal funds.

Caltrans is responsible for implementing the FHWA regulations in California. Under Caltrans policy, a traffic-noise impact occurs if projected noise levels are within 1 dB of the FHWA criteria shown in Table 3.4-4; therefore, a residential impact occurs at 66 dBA  $L_{eq}$ , and a commercial impact occurs at 71 dBA  $L_{eq}$ .



**Table 3.4-4**  
 FHWA Traffic Noise Abatement Criteria

| Land Use Category   |  | Hourly L <sub>eq</sub>                 |
|---------------------|--|--|
| Type A              | 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.   | 57 dBA (exterior)                      |
| Type B <sup>1</sup> | Residential  | 67 dBA (exterior)<br>52 dBA (interior) |
| Type C <sup>1</sup> | Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, daycare 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. | 67 dBA (exterior)                      |
| Type D              | Auditoriums, daycare centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios.  | 52 dBA (interior)                      |
| Type E <sup>1</sup> | Hotels, motels, offices, restaurants/bars, and other developed lands, properties or activities not included in A-D or F.   | 72 dBA (exterior)                      |
| Type 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.   | NA                                     |
| Type G              | Undeveloped lands that are not permitted.  | 72 dBA (exterior)                      |

Source: FHWA Procedures for Abatement of Highway Traffic Noise and Construction Noise (23 CFR 772).  
 Notes:  
<sup>1</sup> Includes undeveloped lands permitted for this activity category.  
 Acronyms:  
 dBA A-weighted decibel(s)  
 FHWA Federal Highway Administration  
 L<sub>eq</sub> Equivalent sound level  
 NA Not Available

**Noise Effects on Wildlife and Domestic Animals**

FRA also addresses impacts on wildlife (mammals and birds) and domestic animals (livestock and poultry). Noise exposure limits for each are an SEL of 100 dBA from passing trains as shown in Table 3.4-5.

**Table 3.4-5**  
 Interim Criteria for High-Speed Train Noise Effects on Animals

| Animal Category | Class               | Noise Metric | Noise Level (dBA) |
|-----------------|---------------------|--------------|-------------------|
| Domestic        | Mammals (Livestock) | SEL          | 100               |
|                 | Birds (Poultry)     | SEL          | 100               |
| Wild            | Mammals             | SEL          | 100               |
|                 | Birds               | SEL          | 100               |

Source: FRA 2005.  
 Acronym:  
 dBA A-weighted decibel(s)

### ***Vibration Criteria – HST Operations***

Ground-borne vibration impacts from HST operations inside vibration-sensitive buildings are defined by the vibration velocity level, expressed in terms of VdB, and the number of vibration events per day of the same kind of source. Table 3.4-6 summarizes vibration sensitivity in terms of the three land use categories and the criteria for acceptable ground-borne vibrations and acceptable ground-borne noise. Ground-borne noise is a low-frequency rumbling sound inside buildings, caused by vibrations of floors, walls, and ceilings. Ground-borne noise is generally not a problem for buildings near railroad tracks at- or above-grade, because the airborne noise from trains typically overshadows effects of ground-borne noise. Ground-borne noise becomes an issue in cases where airborne noise cannot be heard, such as for buildings near tunnels.

The FRA provides guidelines to assess the human response to different levels of ground-borne noise and vibration, as shown in Table 3.4-6. These levels represent the maximum vibration level of an individual train pass-by. A vibration event occurs each time a train passes the building or property and causes discernible vibration. "Frequent Events" are more than 70 vibration events per day, and "Infrequent Events" are fewer than 70 vibration events per day. The guidelines also provide criteria for special buildings very sensitive to ground-borne noise and vibration, such as concert halls, recording studios, and theatres. Table 3.4-7 shows the impact criteria for special buildings.

Tables 3.4-6 and 3.4-7 include separate FRA criteria for ground-borne noise (the "rumble" that radiates from the motion of room surfaces in buildings from ground-borne vibration). Although the criteria are expressed in dBA, which emphasizes the more audible middle and high frequencies, the criteria are significantly lower than airborne noise criteria to account for the annoying low-frequency character of ground-borne noise. Because airborne noise often masks ground-borne noise for aboveground (i.e., at-grade or elevated) high-speed trains, ground-borne noise criteria apply primarily to operations in a tunnel, where airborne noise is not a factor. The Fresno to Bakersfield alignment is planned to be above ground. As a result for the Fresno to Bakersfield corridor, ground-borne noise criteria apply only to buildings with sensitive interior spaces that are well insulated from exterior noise.

In order to determine the actual transmission characteristics of vibration through the soils along the project right-of-way, transfer mobility testing must be conducted. Transfer mobility is a measure of the relationship between the exciting force and the response at each accelerometer position. Eighteen vibration propagation measurements were taken to estimate the vibration transfer mobility along the proposed alignment between Fresno and Bakersfield. This testing showed that all residential structures within a distance of 86 feet and all 4(f) site structures within a distance of 190 feet from the centerline of any proposed at-grade alignment have the potential to be impacted by vibration levels from the HST project. Additional information regarding the transfer mobility testing can be found in the *Fresno to Bakersfield Section: Noise and Vibration Technical Report* (Authority and FRA 2012).

**Table 3.4-6**  
 FRA Ground-Borne Vibration and Ground-Borne Noise Impact Criteria

| Land Use Category   | Ground-Borne Vibration Impact Criteria<br>(VdB relative to 1 micro inch/second) |                                | Ground-Borne Noise Impact Criteria<br>(dB re 20 microPascals) |                                |
|---|---|--------------------------------|---|--------------------------------|
|   | Frequent Events <sup>a</sup>  | Infrequent Events <sup>b</sup> | Frequent Events <sup>a</sup>                                  | Infrequent Events <sup>b</sup> |
| <b>Category 1:</b> Buildings where vibration would interfere with interior operations | 65 VdB <sup>c</sup>   | 65 VdB <sup>c</sup>            | NA <sup>d</sup>   | NA <sup>d</sup>                |
| <b>Category 2:</b> Residences and buildings where people normally sleep               | 72 VdB  | 80 VdB                         | 35 dBA  | 43 dBA                         |
| <b>Category 3:</b> Institutional land uses with primarily daytime use                 | 75 VdB  | 83 VdB                         | 40 dBA  | 48 dBA                         |

Source: FRA 2005.

Notes:

<sup>a</sup> Frequent Events is defined as more than 70 vibration events per day.

<sup>b</sup> Infrequent Events is defined as fewer than 70 vibration events per day.

<sup>c</sup> This criterion limit is based on levels that are acceptable for most moderately sensitive equipment, such as optical microscopes. Vibration-sensitive manufacturing or research will require detailed evaluation to define the acceptable vibration levels. Ensuring lower vibration levels in a building often requires special design of the heating, ventilating and air conditioning systems, and stiffened floors.

<sup>d</sup> Vibration-sensitive equipment is not sensitive to ground-borne noise.

Acronyms:

dB      decibel(s)  
 FRA     Federal Railroad Administration  
 VdB    vibration velocity level

**Table 3.4-7**  
 FRA Ground-Borne Vibration and Ground-Borne Noise Impact Criteria for Special Buildings

| Type of Building or Room | Ground-Borne Vibration Impact Criteria<br>(VdB relative to 1 micro-inch/second) |                                | Ground-Borne Noise Impact Criteria<br>(dB relative to 20 microPascals) |                                |
|--------------------------|---|--------------------------------|--|--------------------------------|
|                          | Frequent Events <sup>a</sup>  | Infrequent Events <sup>b</sup> | Frequent Events  | Infrequent Events <sup>b</sup> |
| Concert Hall             | 65 VdB  | 65 VdB                         | 25 dBA   | 25 dBA                         |
| TV Studio                | 65 VdB  | 65 VdB                         | 25 dBA   | 25 dBA                         |
| Recording Studio         | 65 VdB  | 65 VdB                         | 25 dBA   | 25 dBA                         |
| Auditorium               | 72 VdB  | 80 VdB                         | 30 dBA   | 38 dBA                         |
| Theater                  | 72 VdB  | 80 VdB                         | 35 dBA   | 43 dBA                         |

Source: FRA 2005.

Notes:

<sup>a</sup> *Frequent Events* is defined as more than 70 vibration events per day.

<sup>b</sup> *Infrequent Events* is defined as fewer than 70 vibration events per day.

Acronyms:

dB      decibel(s)  
 dBA     A-weighted decibel(s)  
 VdB    vibration velocity level

### **Construction Noise Impact Methodology**

The construction noise impact assessment used the methodology described in the FTA guidance manual (FTA 2006). The contractor and the Authority will make decisions regarding procedures and equipment. For this analysis construction scenarios for typical railroad construction projects are used to predict noise impacts. The construction noise and vibration methodology includes the following:

- Noise emissions from equipment expected to be used by contractors.
- Construction methods using the equipment identified above.
- Usage scenarios for how the equipment will be operated.
- Estimated site layouts of equipment along the right-of-way.
- Relationship of the construction operations to nearby noise-sensitive receivers.

Table 3.4-1 above lists FTA criteria for the maximum acceptable 8-hour noise levels ( $L_{eq}$ ) for daytime and nighttime. It also shows the 30-day average  $L_{dn}$  values for long-term construction projects.

### **Criteria for Construction Noise Impact Assessment**

The construction noise assessment is based on guidelines included in the FTA guidance manual (FTA 2006), as well as consideration of local noise ordinances, which are presented in the *Fresno to Bakersfield Section: Noise and Vibration Technical Report*. The Authority applies uniform noise and vibration criteria for construction based on FTA and FRA guidance.

Table 3.4-1 shows FTA assessment criteria for construction noise. An 8-hour  $L_{eq}$  and a 30-day average noise exposure are used to assess impacts. A 30-day average  $L_{dn}$  is used to assess impacts in residential areas, and a 30-day average 24-hour  $L_{eq}$  is used to assess impacts in commercial and industrial areas. The noise emission levels of the construction equipment, utilization factor, hours of operation, and location of equipment are used to calculate 8-hour and 30-day average noise exposures.

### **Construction Vibration Impact Methodology**

The FTA guidance manual (FTA 2006) provides the methodology for the assessment of construction vibration impact. Estimated construction scenarios have been developed for typical railroad construction projects allowing a quantitative construction vibration assessment to be conducted. Construction vibration is assessed quantitatively where a potential for blasting, pile-driving, vibratory compaction, demolition, or excavation close to vibration-sensitive structures exists. Criteria for annoyance (see Tables 3.4-6 and 3.4-7) and damage (see Table 3.4-2) were applied to determine construction vibration impacts. The methodology included:

- Vibration source levels from equipment expected to be used by contractors.
- Estimated site layouts of equipment along the right-of-way.
- Relationship of the construction operations to nearby vibration-sensitive receivers.

### **Train Operation Noise and Vibration Methodology**

HST operation noise and vibration levels were projected using current HST System operation plans and the prediction models provided in the FRA guidance manual (FRA 2005). Potential noise and vibration impacts also were evaluated in accordance with the FRA guidance manual. Section 3.4.3.3 describes the applicable criteria; this section, as well as the Noise and Vibration Technical Report, provide further detail about the assessment methodology, including modeling assumptions. The assumptions for train operation are listed below, followed by the methodologies:

- Noise modeling projections assumed atmospheric absorption of sound based on the International Standard ISO 9613-2.
- The noise analysis used source reference levels for the VHS Electric vehicle type listed in Table 5-2 of the FRA Guidance Manual (FRA 2005). These adjustments assumed that trainsets would be distributed-power EMU vehicles with 8 cars and a maximum speed of 220 mph.
- The noise sources included the wheel/rail interface at one foot above top of rail, the propulsion noise at 2 feet above top of rail, and the aerodynamic noises from the train nose (at 10 feet above top of rail), the wheel region (at 5 feet above top of rail), and the pantograph (at 15 feet above top of rail).
- HST track was assumed to be a combination of ballast and slab track with continuous welded rail, consistent with the assumptions in the FRA guidance manual (FRA 2005). Slab construction will be used for elevated structures exceeding 1,000 feet in length, where operating speeds are planned for 220-mph operations. Slab track would be 3 dB louder than ballast and tie track, because of the decreased acoustic absorption compared to that provided by the ballast, and changes to the track stiffness.
- Modeling used the full system schedule of train operations as outlined in Chapter 2 of this document and detailed in the Fresno to Bakersfield Noise and Vibration Technical Report.
- Maximum speed was assumed to be 220 mph along the corridor depending upon speed profiles provided by Project Design files and interpreted by Parsons Brinckerhoff, Inc. in July 2010.
- Top of rail elevations are based on 15% preliminary design as available March 2011.
- The track was assumed to be on aerial structure wherever top-of-rail elevations are more than 20 feet above existing grade.
- All aerial structure sections of the corridor were assumed to be as described in the Technical Memorandum "TM 1.1.21 Typical Cross Section 15% R0 090404 TM Excerpt.pdf."
- Buildings within the property acquisition footprint were not to be included in the impact assessment because they were assumed to be acquired as part of the HST footprint.
- There would be several closures of existing roadway/freight train/Amtrak train at-grade crossings along the corridor on the BNSF Alternative. A road overcrossing would separate both the HST and the BNSF freight line. Trains passing through the existing at-grade crossings between roadways and freight/Amtrak railroad tracks currently are required to blow their horns as a warning to oncoming traffic and pedestrians. Noise modeling projections assumed no change to any of the existing at-grade crossings and, therefore, no change to locations where the freight and Amtrak trains will blow their horns. There would be no at-grade crossings for HSTs.
- No adjustments were made to projected noise levels to account for increases in localized noise due to special trackwork, such as crossovers and turnouts, since the project will use special trackwork which will not have gaps associated with crossovers.
- No noise exposure effects were assumed associated with changes in freight rail or Amtrak operations due to the implementation of the HST project.

- Projections accounted for reduced noise emissions from the acoustic shielding provided by the trenches proposed through Fresno and along the Hanford West Bypasses.

Project analysts tabulated projected noise and existing ambient noise exposures at the identified receivers or clusters of receivers. The analysts found the levels of impact (no impact, moderate impact, or severe impact) by comparing the existing and project noise exposure based on the impact criteria shown in Figure 3.4-3.

### ***Station Noise***

Project analysts assessed the noise impacts associated with HST stations in the cities of Fresno and Bakersfield and in Kings County at each noise-sensitive receiver by using the FTA methodology in the guidance manual (FTA 2006, Section 6.7). The detailed noise analysis included a measurement program at representative clusters of receivers to determine existing ambient noise conditions and a noise prediction method to determine future noise conditions. The noise predictions at these receivers were based on the following information:

- Type of train equipment to be used.
- Train schedules (number of stopping trains and number of through trains during daytime and nighttime hours).
- Train consists (number of cars).
- Speed profiles of stopping trains and through trains.
- Plans and profiles of elevated station structures.
- Landform topography such as buildings in the immediate vicinity of the station.

Project analysts tabulated the projected noise and existing ambient noise exposures at the identified receivers or clusters of receivers. The analysts then determined the levels of impact (no impact, moderate impact, or severe impact) by comparing the existing and project noise exposure with the impact criteria shown in Figure 3.4-3.

### ***Traffic Noise at Stations, Parking Facilities, and Grade-Separations***

In addition to noise from HST operations, project analysts assessed changes in traffic volume, primarily near the proposed HST station sites. Traffic on local roads provides only a minor contribution to overall noise levels. In addition, because the dominant noise source at stations would be the HST through trains moving at 220 mph, any changes in traffic near the stations would provide only a minor contribution to the project noise at stations.

### ***Stationary HST-Related Noise Sources***

Noise from other railroad noise sources than HSTs includes noise from the three types of maintenance facilities (heavy maintenance, maintenance-of-way, and overnight servicing) and electrical power substations.

The noise analysis used FTA (2006) methodology to analyze noise from the HST traction power substations, maintenance facilities, and activities associated with maintenance, repair, and storage of HSTs. Source noise included wheel squeal as the trains pass through the curved sections at the ends of the storage tracks, shop activities, railcar washes, and warning horns.

#### **3.4.3.4 Methods for Evaluating Effects under NEPA**

Pursuant to NEPA regulations (40 CFR 1500-1508), project effects are evaluated based on the criteria of context and intensity. Context means the affected environment in which a proposed project occurs. Intensity refers to the severity of the effect, which is examined in terms of the type, quality, and sensitivity of the resource involved, location and extent of the effect, duration

of the effect (short- or long-term), and other consideration of context. Beneficial effects are identified and described. When there is no measurable effect, impact is found not to occur. The intensity of adverse effects is the degree or magnitude of a potential adverse effect, described as negligible, moderate, or substantial. Context and intensity are considered together when determining whether an impact is significant under NEPA. Thus, it is possible that a significant adverse effect may still exist when on balance the impact is negligible or even beneficial.

For this assessment, FRA terminology of no impact was used rather than the NEPA term negligible.

If the project results in a change in the cumulative noise level that would not be noticeable to a significant number of people, there would be no impact (FRA's "No Impact" category, as shown in Figure 3.4-3). If the project results in a change in the cumulative noise level that would be noticeable to most people, but may not be sufficient to generate strong, adverse reactions, the impact is defined as having moderate intensity (FRA's "Moderate Impact" category, as shown in Figure 3.4-3). If the project results in a change in the cumulative noise level that would cause a significant percentage of people to be highly annoyed by the project's noise, the impact is defined as having substantial intensity (FRA's "Severe Impact" category, as shown in Figure 3.4-3). Because of the significant percentage of people who would be highly annoyed, the noise impacts with substantial intensity would be considered significant under NEPA. The context for noise effects is the background noise and sensitivity of receptors (with rural residential equaling less noise and fewer receptors versus urban residential near existing noise emitters, such as railroads and freeways).

For vibration, all impacts, as defined by the FRA criteria in Section 3.4.3.3, would be considered to have substantial intensity. Because there is only one level of impact in the FRA criteria, all project vibration impacts over the impact criteria would be considered significant.

#### 3.4.3.5 CEQA Significance Criteria

The FRA noise and vibration criteria for evaluating effects under NEPA may be used as the CEQA significance criteria. In addition to these criteria, CEQA guidelines also define an impact pertaining to noise and vibration as considered significant if it would result in any of the following environmental effects:

- Exposure of persons to or generation of noise levels in excess of standards for a severe impact established by the FRA for high-speed ground transportation and by the FTA for transit projects. These standards cover both permanent and temporary/periodic increases in ambient noise levels in the project vicinity above levels existing without the project.
- Exposure of persons to or generation of excessive ground-borne vibration or ground-borne noise levels.

#### 3.4.3.6 Study Area for Analysis

##### Noise Study Area

The noise study area of the proposed project includes sensitive receivers that are located up to approximately 2,500 feet from the proposed track centerline. This study area has been determined based on typical screening distances (see Table 3.4-8) as defined by FRA and project-specific conditions. Screening distances indicate whether any noise-sensitive receivers are near enough to the proposed alignment for a noise impact to be possible under typical conditions. If receivers are located farther than these screening distances, FRA guidance has determined that impacts would be unlikely. Table 3.4-8, which groups screening distances by the

type of corridor the project would occupy, takes into account whether the HST alignment follows along an existing rail line or highway or along a new transportation corridor.

The FRA has three speed ranges in its screening methodology; the highest speed range category (Regime III – 170 mph or greater) was used to define the Fresno to Bakersfield HST alignment screening distance. These screening distances are based on general assumptions associated with typical projects such as the number of train operations, train speeds, and existing noise conditions. The specific factors of the HST Project were considered when the potential impact was assessed for all noise-sensitive receivers within approximately 2,000 feet. One of the primary reasons that the study area extends farther than the typical screening distances is that some areas have relatively low existing noise conditions.

**Table 3.4-8**  
 Screening Distances for High-Speed Rail Speed Regime III<sup>a</sup>

| Corridor Type | Existing Noise Environment                                | Screening Distance for Train Type and Speed Regime <sup>b</sup> |
|---------------|---|---|
| Railroad      | Urban/noisy suburban – unobstructed                       | 700 feet  |
|               | Urban/noisy suburban – intervening buildings <sup>c</sup> | 300 feet  |
|               | Quiet suburban/rural                                      | 1,200 feet  |
| Highway       | Urban/noisy suburban – unobstructed                       | 600 feet  |
|               | Urban/noisy suburban – intervening buildings <sup>c</sup> | 350 feet  |
|               | Quiet suburban/rural                                      | 1,100 feet  |
| New           | Urban/noisy suburban – unobstructed                       | 700 feet  |
|               | Urban/noisy suburban – intervening buildings <sup>c</sup> | 350 feet  |
|               | Quiet suburban/rural                                      | 1,300 feet  |

Source: FRA 2005.  
<sup>a</sup> 170 mph or greater.  
<sup>b</sup> Measured from centerline of alignment. Minimum distance is assumed to be 50 feet.  
<sup>c</sup> Rows of buildings are assumed to be at 200, 400, 600, 800, and 1,000 feet away, parallel to the alignment.

Acronym:  
 mph      mile(s) per hour

**Vibration Study Area**

For the proposed project, the study area for vibration is as follows:

- HST station study area: 150 feet from the station boundary.
- HST alignment study areas, including existing railroads: up to 275 feet from the edge of the right-of-way.
- Highway study areas: 50 feet from the roadway centerline.

The vibration impact assessment uses the FRA screening procedure. Screening distances indicate the potential for vibration impact on vibration-sensitive receivers. FRA guidance has determined that receivers located beyond the screening distances are not likely to be affected by the HST. Table 3.4-9 presents the screening distances for vibration assessment.



**Table 3.4-9**  
 FRA Screening Distances for Vibration Assessment

| Land Use      | Train Frequency <sup>a</sup> | Screening Distance (feet)     |                               |
|---------------|------------------------------|-------------------------------|-------------------------------|
|               |                              | Train Speed of 100 to 200 mph | Train Speed of 200 to 300 mph |
| Residential   | Frequent                     | 220                           | 275                           |
|               | Infrequent                   | 100                           | 140                           |
| Institutional | Frequent                     | 160                           | 220                           |
|               | Infrequent                   | 70                            | 100                           |

Source: FRA 2005.  
 Note:  
<sup>a</sup> Frequent = greater than 70 pass-bys per day; Infrequent = less than 70 pass-bys per day.  
 Acronym:  
 mph mile(s) per hour

The study areas for the vibration impact assessment analysis generally follow the HST corridor between Fresno and Bakersfield. Most of the study area along the north-south alignment lies along active railroad and highway rights-of-way. Vibration study areas are defined within the FRA vibration screening distances as ranging from 220 feet for institutional land uses to 275 feet for residential land uses (see Table 3.4-9).

**3.4.4 Affected Environment**

The affected environment follows the Fresno to Bakersfield HST corridor along the BNSF Railway (BNSF) tracks from the downtown area of the City of Fresno to the downtown area of the City of Bakersfield. This region includes areas and communities within the incorporated boundaries of the cities of Fresno, Hanford, Corcoran, Wasco, Shafter, and Bakersfield. This region also includes unincorporated communities within the counties of Fresno, Kings, Tulare, and Kern. The areas within the cities of Fresno, Corcoran, Wasco, Shafter, and Bakersfield are considered urban or suburban, and most of the unincorporated areas between these cities are considered rural. The proposed end-point station locations fall within the urban areas of the cities of Fresno and Bakersfield. In the Hanford area there are two proposed stations. The Kings/Tulare Regional Station-West is to the west of Hanford near the intersection of State Route 198 and State Route 43. This station is the proposed station if the BNSF Alternative is selected in the Hanford area and is in a rural setting. The Kings/Tulare Regional Station-East is to the east of Hanford near the intersection of State Route 198 and 12<sup>th</sup> Ave. This station has an at-grade and below-grade option and would be constructed if either the Hanford West Bypass 1 Alternative or the Hanford West Bypass 2 Alternative is selected and is also in a rural setting. Most of the project areas described above as urban or suburban are also along active rail corridors, as are most of the rural areas.

There are no applicable regional plans or policies pertaining to noise and vibration within the Fresno to Bakersfield Section study area.

**3.4.4.1 Existing Noise Levels**

To establish a base for existing environmental noise levels for the project noise impact assessment, a comprehensive series of noise measurements were made within the study area. A

combination of 229 long-term (24 hours in duration) and 229 short-term (generally 60 minutes in duration) noise measurements were taken at noise-sensitive receivers. Multiple measurements were made at some measurement sites. The ambient noise level measurement locations were selected to be representative of the noise environment most likely to be impacted by train noise. Measurements were completed at single-family and multi-family residences for long-term measurements. Short-term measurements were completed at residential and institutional sites (e.g., hospitals, libraries, schools, and churches).

The noise measurement locations are shown graphically on Figures 3.4-4 through 3.4-8. Summaries of the long- and short-term noise measurements are presented in Appendix 3.4-A NV Table 1 (long-term measurements) and Appendix 3.4-A NV Table 2 (short-term measurements). Each measurement site listed in these tables consists of the measurement location identification number, location address, a summary of noise sources, additional notes, and the resulting noise level.

The short-term noise measurements in Appendix 3.4-A NV Table 2 include the actual measured short-term  $L_{eq}$  values and the estimated  $L_{dn}$  values. These values were estimated by comparing the short-term measured values to the corresponding  $L_{eq}$  values at a nearby long-term measurement location that is subjected to a similar noise environment using the following method:

- A. Note the  $L_{eq}$  value for the short-term measurement (60 minutes).
- B. Compare the monitored short-term (ST)  $L_{eq}$  value from step A to the monitored  $L_{eq}$  value for the nearby long-term (LT) measurement location for the same measurement period used for the short-term (ST)  $L_{eq}$  value.

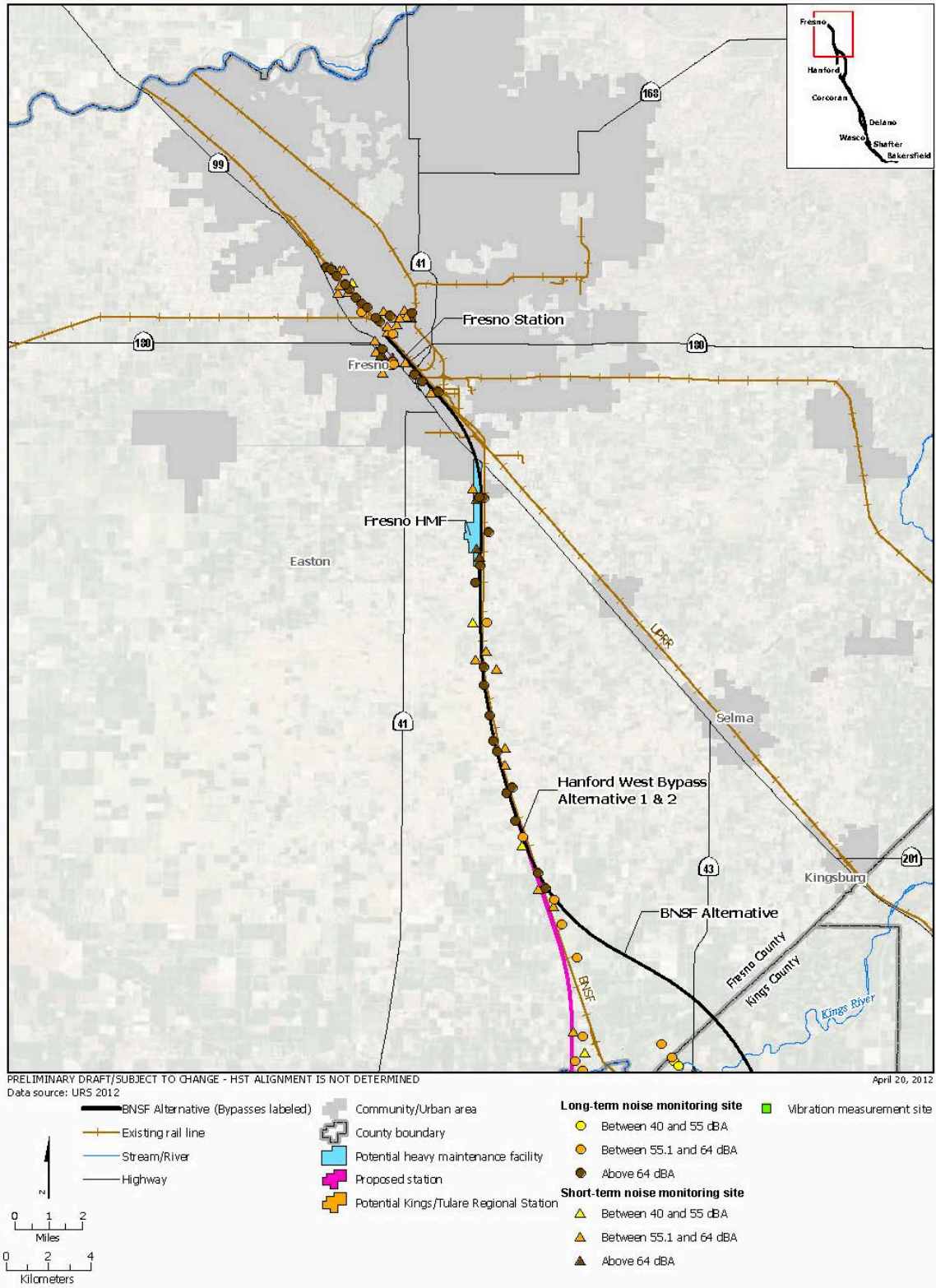
Then

$$L_{eq} (ST) - L_{eq(simultaneous)} (LT) = \text{delta}$$

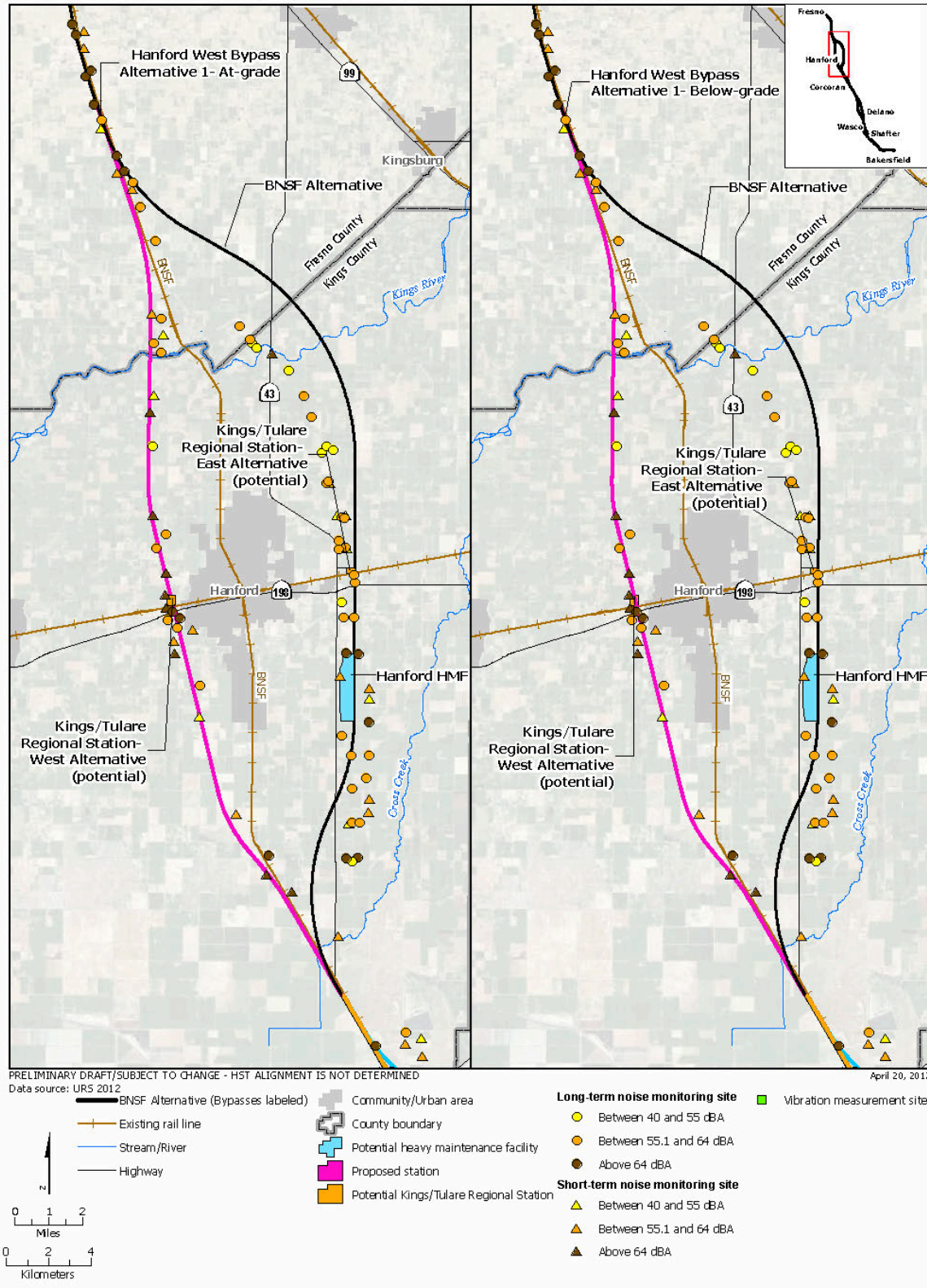
and

$$L_{dn} (ST) = L_{dn} (LT) + \text{delta}.$$

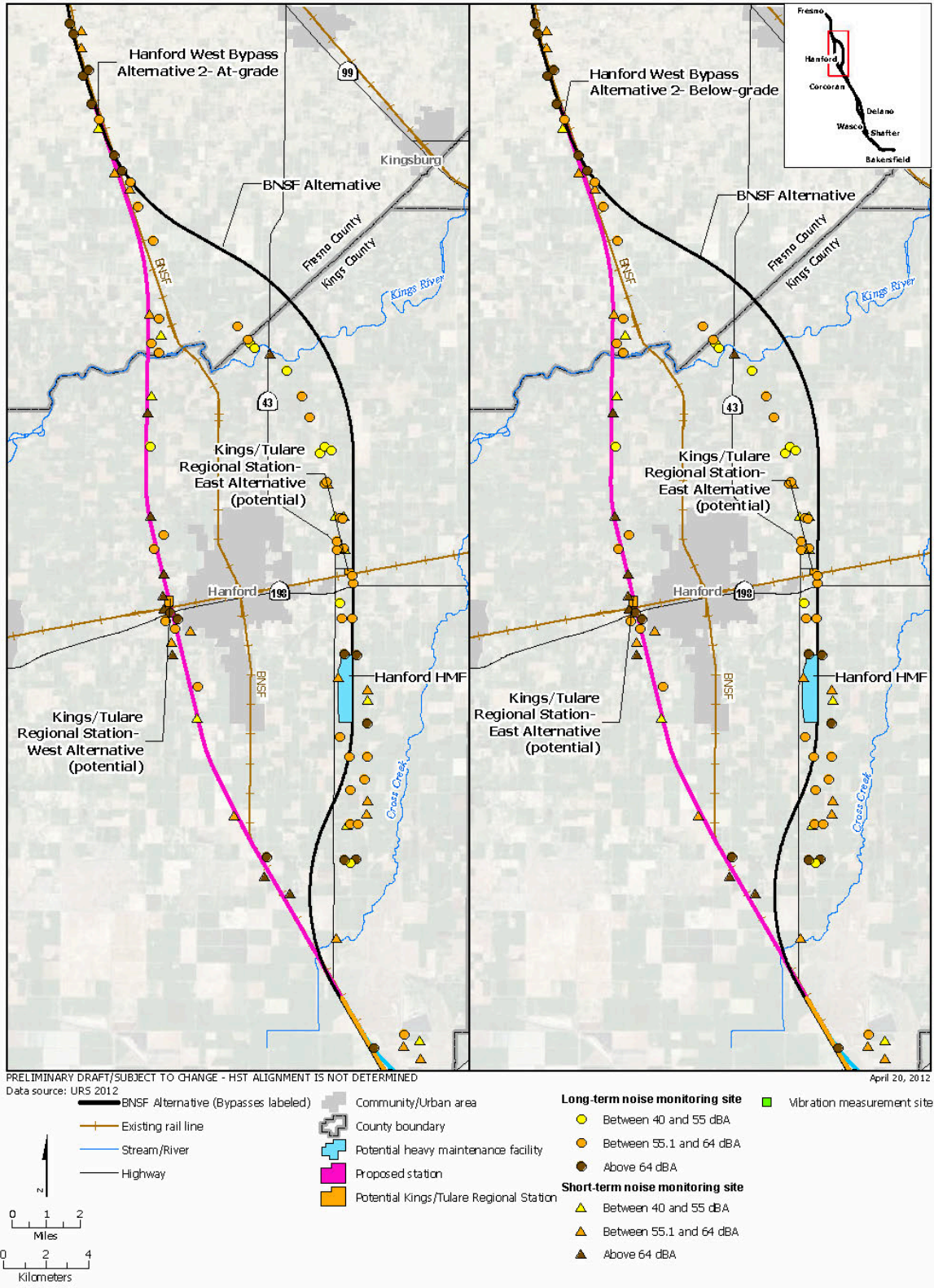
The area around the proposed station in Fresno is developed primarily with commercial and industrial land uses, with some residential land uses mixed in. The noise environment in this area is dominated by traffic on the local streets, traffic on the freeways that surround the downtown area, and noise from train operations along the Union Pacific Railroad mainline. Noise levels were measured at the noise-sensitive land uses throughout the area, as indicated in Section 3.4.3, and the measured noise levels ranged from 61 dBA  $L_{dn}$  along one of the quieter streets to 72 dBA  $L_{dn}$  near the railroad. These noise levels are typical for urban settings dominated by vehicular traffic and railroad operations. The alternative alignment would proceed southeast from the Fresno station, pass State Route (SR) 41 and approach the BNSF rail yard. The sensitive land uses in this area are subject to more roadway and railroad noise; the noise levels measured here range from 68 to 75 dBA  $L_{dn}$ .



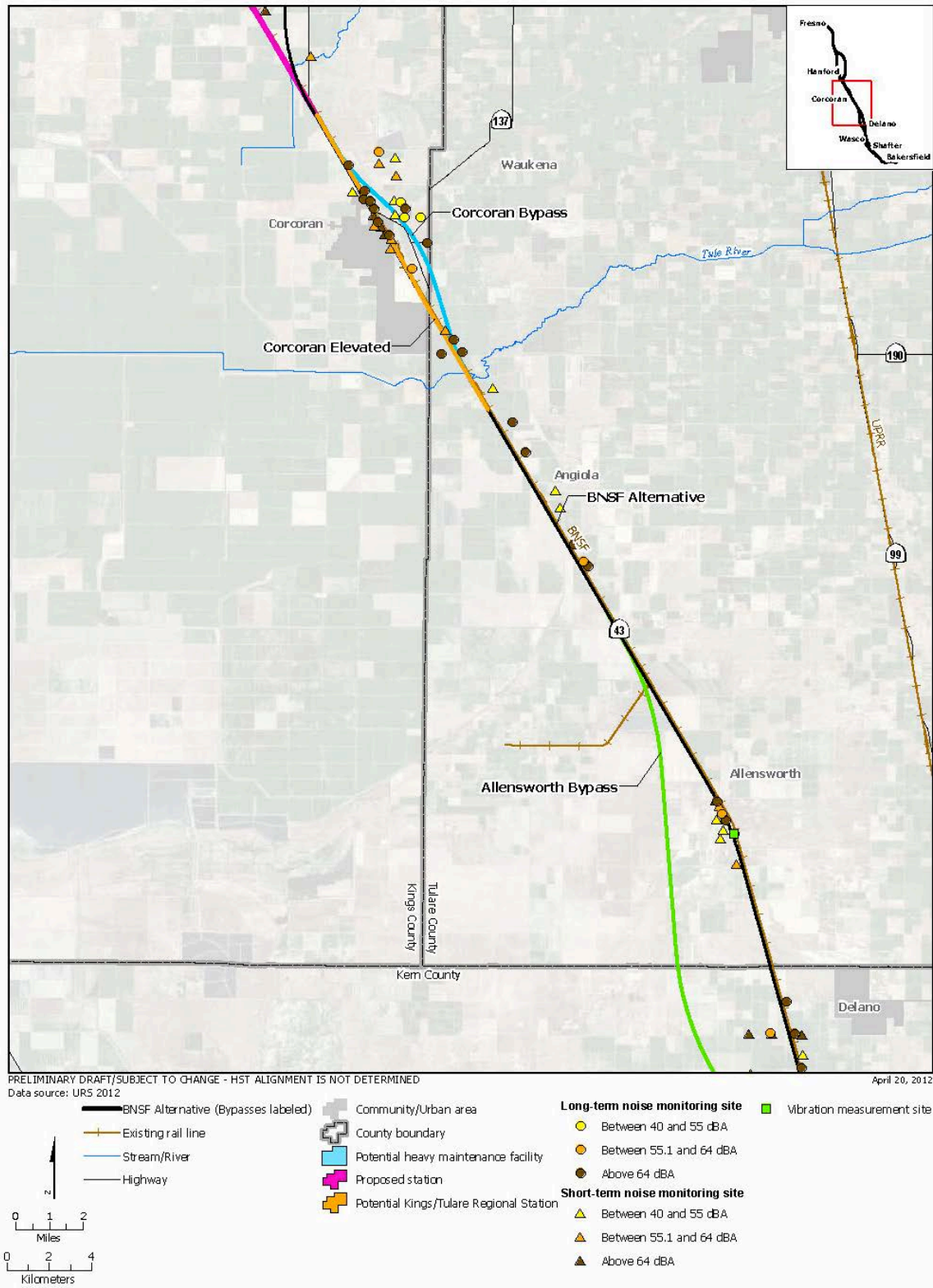
**Figure 3.4-4**  
 Fresno area: Noise and vibration measurement sites



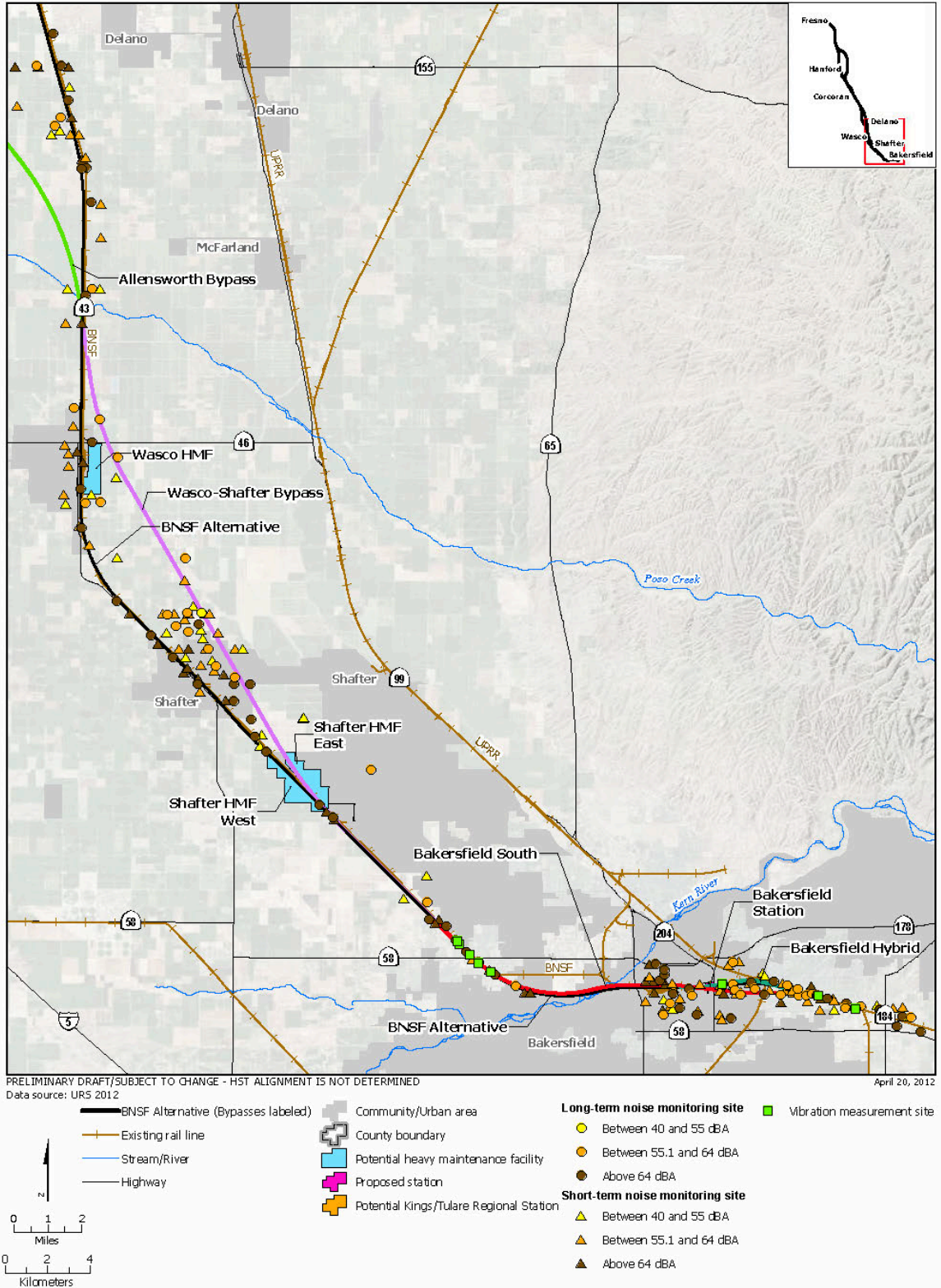
**Figure 3.4-5**  
 Hanford / Alt 1 area: Noise and vibration measurement sites



**Figure 3.4-6**  
 Hanford /Alt 2 area: Noise and vibration measurement sites



**Figure 3.4-7**  
 Corcoran area: Noise and vibration measurement sites



**Figure 3.4-8**  
 Bakersfield area: Noise and vibration measurement sites

After the alignment passes Jensen Avenue, it turns to the south to follow the BNSF alignment, passing over SR 99. South of East Malaga Avenue, the alignment runs along the western side of the BNSF right-of-way, between Cedar Avenue to the west and Maple Avenue to the east. The land uses in this area are primarily agricultural, with homes mostly along Cedar Avenue and Maple Avenue. One of the homes adjacent to the existing railroad line experienced a noise level of 79 dBA  $L_{dn}$ . This site was dominated by train noise, with a total of 44 trains passing this location in a 24-hour period. Another home farther south that is approximately 900 feet from the existing railroad experienced a noise level of 58 dBA  $L_{dn}$ , which is significantly quieter.

From this point, the project alignment follows the BNSF for approximately 12 miles through primarily agricultural lands in the community of Monmouth in the unincorporated area of Fresno County. Along this portion of the alternative alignments, the measured ambient noise levels near train operations ranged from 64 to 77 dBA  $L_{dn}$ . These noise levels are to be expected in areas near freight and passenger train operations. The median measured noise level for these same sites without train operations ranged from 36 to 44 dBA  $L_{dn}$ ; these noise levels are comparable to the inside of a house during a quiet evening.

After crossing Conejo Avenue, the project alignment turns to the southeast, away from the BNSF right-of-way, to bypass the community of Laton and to run around the eastern side of Hanford where the Kings/Tulare Regional Station is proposed. The land uses in the area continue to be primarily agricultural. The measured ambient noise levels between Laton and SR 198 ranged from 47 to 63 dBA  $L_{dn}$ . These noise levels are consistent with a rural environment with some vehicular traffic. The project alignment runs on the eastern side of SR 43 as it turns south toward Corcoran. It runs halfway between 7th Street and 8th Street. The land uses along the alignment between SR 198 and Corcoran are primarily dairy farms and fields of alfalfa. The measured ambient noise levels in this area range from 52 dBA  $L_{dn}$  at the homes away from busy roadways to 72 dBA  $L_{dn}$  for the homes adjacent to the main arterials.

Both the Hanford West Bypass 1 Alternative and the Hanford West Bypass 2 Alternative alignments deviate from the BNSF Alternative after crossing Elkhorn Avenue and head south along the western side of Hanford. The land use along these alternative alignments is primarily agricultural and residential. The measured ambient noise levels along the alternatives ranged from 48 dBA  $L_{dn}$  at the mid-end of the alternative alignments to 77 dBA  $L_{dn}$  at the southern end of the alternative alignments. These noise levels are to be expected for an agricultural environment with irregular farming activities taking place.

Just south of Idaho Avenue, the project alignment curves to the southwest, crosses SR 43, then curves to the left in order to meet up with the BNSF alignment on the northern side of Corcoran. South of Nevada Avenue, the Corcoran Bypass Alternative curves toward the east to bypass Corcoran around the eastern side. Noise measurements made along the alignment through the City of Corcoran ranged from 64 to 81 dBA  $L_{dn}$ . These noise levels are consistent with homes adjacent to commercial and industrial sites that are exposed to highway traffic and railroad operations. Around the eastern side of Corcoran, noise levels measured at homes away from SR 43 and other major roads ranged from 48 to 61 dBA  $L_{dn}$ .

South of Corcoran, the BNSF Alternative and the Corcoran Bypass Alternative rejoin between Avenue 144 and Avenue 136, and run along the western side of SR 43. The land use in the area is agricultural, with a mix of orchards, alfalfa, and dairy. The noise levels measured along the Pixley Alignment ranged from 59 to 70 dBA  $L_{dn}$ . These noise levels are consistent with expectations for homes along a two-lane highway and an active rail line.

In the vicinity of Allensworth, the measured noise levels for the homes near the BNSF right-of-way ranged from 62 to 76 dBA  $L_{dn}$ . For homes farther from the tracks, the measured noise levels were from 47 to 63 dBA  $L_{dn}$  levels that would be expected for a reasonably quiet neighborhood.



For the homes near both SR 43 and the BNSF right-of-way, the measured noise levels ranged from 71 to 74 dBA  $L_{dn}$ .

South of Avenue 84, the Allensworth Bypass Alignment curves to the south in order to go around the Allensworth Historic Park and the Pixley Wildlife Refuge to the west. The Allensworth Bypass Alignment rejoins the BNSF Alternative at Whisler Road, just north of the City of Wasco. The Wasco-Shafter Bypass alignment curves to the southeast to avoid the cities of Wasco and Shafter, while the BNSF Alternative goes through the downtown areas of the cities of Wasco and Shafter, following the BNSF right-of-way as much as is practicable. The noise levels measured along the BNSF Alternative through these cities generally ranged from 70 to 79 dBA  $L_{dn}$ . These levels reflect the proximity to an active freight rail line.

The Wasco-Shafter Bypass Alternative goes through agricultural land and through some of the least-populated areas along the alternative alignment. Noise levels measured along this alternative ranged from 54 to 61 dBA  $L_{dn}$ , which are levels to be expected in a quiet, rural environment. For the homes next to the well-traveled roadways, the noise levels ranged from 67 to 71 dBA  $L_{dn}$ .

South of Reina Road, the land uses transition from agricultural to residential, with several neighborhoods of single-family dwellings. Along this portion of the alternative alignments, noise measurements were conducted in the rear yards of homes that back up to the existing BNSF right-of-way. The noise levels measured at these homes ranged from 65 to 77 dBA  $L_{dn}$ . These levels are reflective of homes directly adjacent to a busy railroad line. Beyond this point, the BNSF line and the project alternatives turn east toward the freight yard and station at Bakersfield. The land uses here are urban: roadways, freeways, and rail lines dominate the noise environment. The noise measurements conducted near the alternative alignments and the proposed downtown Bakersfield station alternatives in this area ranged from 59 to 70 dBA  $L_{dn}$ , which are consistent with an urban environment.

### **Heavy Maintenance Facility Alternatives**

- Fresno Works – Fresno: The land uses in this area are primarily agricultural, with scattered housing units in the area. One of the homes adjacent to the existing railroad line experienced a noise level of 79 dBA  $L_{dn}$ . This site was dominated by train noise, with a total of 44 trains passing this location in a 24-hour period. Another home farther south that is approximately 900 feet from the existing railroad experienced a noise level of 58 dBA  $L_{dn}$ .
- Kings County – Hanford: The land uses in the area continue to be primarily agricultural with adjacent rural community. The measured ambient noise levels ranged from 47 to 63 dBA  $L_{dn}$ . These noise levels are consistent with a rural environment with some vehicular traffic.
- Kern Council of Governments – Wasco: The noise levels measured were generally ranged from 70 to 79 dBA  $L_{dn}$ . These levels reflect the urban environment and the proximity to an active freight rail line.
- Kern Council of Governments – Shafter East: Noise levels generally ranged from 54 to 61 dBA  $L_{dn}$ , which are levels to be expected in a quiet, rural environment. For the homes next to the well-traveled roadways, the noise levels ranged from 67 to 71 dBA  $L_{dn}$ .
- Kern Council of Governments – Shafter West: Noise levels generally ranged from 54 to 61 dBA  $L_{dn}$ , which are levels to be expected in a quiet, rural environment. For the homes next to the well-traveled roadways, the noise levels ranged from 67 to 71 dBA  $L_{dn}$ .

### 3.4.4.2 Existing Vibration Levels

Project analysts identified vibration sensitive areas (VSAs) within the study area by locating the vibration-sensitive land use categories listed in Table 3.4-6 (i.e., residential and institutional) within an appropriate screening distance from the proposed HST alternatives. The screening distances used to identify VSAs are based on FRA guidance, as listed in Table 3.4-9. Some of these VSAs are exposed to existing sources of ground-borne vibration. The existing levels were measured by placing vibration sensors at representative vibration-sensitive locations throughout the corridor along the UPRR and BNSF tracks.

Vibration measurements were conducted at 9 locations representative of actual potentially impacted areas that were within 220 feet of a HST alternative alignment and within approximately 250 feet of an existing active rail line. The field vibration data were processed in an appropriate fashion for comparison with established FTA/FRA impact criteria (i.e., maximum event vibration level) and then compared with the value generated by the FTA general vibration assessment procedure (using the Generalized Ground Surface Vibration Curve for “locomotive powered passenger or freight”). The values calculated using this FTA method are described as representing the “upper range of measurement data for a well-maintained system,” so it is expected that the majority of the field measurements collected for this project would be at or below the FTA-predicted value.

Appendix 3.4-A NV Table 3 presents a summary of the vibration measurements, including measured vibration levels for various train-related vibration events and a comparison with predicted values using the FTA prediction method. Appendix D of the *Fresno to Bakersfield Section: Noise and Vibration Technical Report* (Authority and FRA 2012) provides additional detail on the field vibration measurements, including a sample of the field documentation procedures.

Appendix 3.4-A NV Table 3 shows the measured vibration levels were generally equal to or less than the levels predicted by the (conservative) FTA method (generally within about 0 to -8 VdB). Two of the 9 measured locations (Vib-02 and Vib-07) displayed some vibration levels higher than those predicted by the FTA method. The apparently efficient vibration propagation characteristics at these two locations were taken into account during the impact assessment. Several events were more than 10 VdB lower than the predicted values. These results may have been due to either less efficient soil propagation characterizations at these locations or simply lower-than-predicted isolated events. The predicted levels included the expectation of flat spots on the wheels, which are common on mixed freight trains and much less so on Amtrak trains. Perhaps the lower levels were due to lower actual train speeds than those estimated in the field.

Overall, a majority of the measurements were between 70 and 80 VdB with the highest measured vibration level being 92 VdB and the lowest measurement being 59 VdB. Specific vibration measurements were not taken at the proposed station locations as none of the stations had sensitive receivers within the FRA screening distances. It is estimated that none of the station alternatives are expected to have vibration levels above residential standards.

#### **Heavy Maintenance Facility (HMF) Alternatives**

Similar to the proposed station alternatives, none of the HMF alternative sites had sensitive receivers within the FRA screening distances. Therefore, it is estimated that none of the HMF alternatives are expected to have vibration levels be above residential standards.

### 3.4.5 Environmental Consequences

#### 3.4.5.1 Overview of Project Impacts

Operation of the HST along the Fresno to Bakersfield Section would increase noise levels above the ambient noise environment by as much as 22 dBA  $L_{dn}$  (Authority and FRA 2012). Project noise impacts are highly dependent on the number of trains operated; and the impacts presented are the maximum anticipated with full system operations. Initial stages of system development would have considerably lower noise impacts. Tables 3.4-10 and 3.4-11 summarize the number of noise impacts with moderate and severe intensity by alternative, from high ridership conceptual HST operations and the HMF, respectively. For sections of the alignment to be constructed on slab track, noise levels from HST operations would be 3 dB higher than for ballast and tie track, resulting in additional noise impact.

**Table 3.4-10**  
 Summary of Noise Impacts by Project Alternative from HST Operations

| BNSF Alternative | Total Number of Impacts before Mitigation                                      |   | Project Alternative                      | Total Number of Impacts before Mitigation      |   |
|------------------|--|---|--|--|---|
|                  | Moderate   | Severe  |  | Moderate                                       | Severe  |
| BNSF Total       | 9,363 residences, 35 churches, 21 schools, 1 hospital, 7 parks, 22 historical, | 4,440 residences, 25 churches, 6 schools, 2 hospitals, 3 parks, 31 historical | NA                                       | NA   | NA  |
| Hanford East     | 124 residences, 1 school   | 176 residences, 1 school, 1 historical  | Hanford West Alternative 1 (At-Grade)    | 382 residences, 1 school, 1 park, 1 historical | 226 residences, 2 schools, 1 park, 3 historical |
|                  |  |   | Hanford West Alternative 1 (Below Grade) | 162 residences, 2 schools, 1 park              | 227 residences, 1 park, 3 historical            |
|                  |  |   | Hanford West Alternative 2 (At-Grade)    | 363 residences, 1 school, 1 park, 2 historical | 247 residences, 2 schools, 1 park, 2 historical |
|                  |  |   | Hanford West Alternative 2 (Below Grade) | 109 residences, 1 school, 1 park               | 282 residences, 1 school, 1 park, 3 historical  |

**Table 3.4-10**  
 Summary of Noise Impacts by Project Alternative from HST Operations

| BNSF Alternative      | Total Number of Impacts before Mitigation                 |  | Project Alternative            | Total Number of Impacts before Mitigation                                   |  |
|-----------------------|---|--|--------------------------------|---|--|
|                       | Moderate  | Severe   |                                | Moderate  | Severe   |
| Through Corcoran West | 644 residences, 2 churches, 2 schools, 1 hospital, 1 park | 419 residences, 1 church, 1 park, 1 historical                       | Through Corcoran East          | 745 residences, 2 churches, 3 schools, 1 hospital, 1 park                   | 450 residences, 1 church, 1 park, 1 historical                               |
|                       |   |  | Corcoran Bypass                | 96 residences   | 110 residences, 1 school   |
| Through Allensworth   | 32 residences, 1 school                                   | 12 residences, 1 park, 1 historical                                  | Allensworth Bypass             | 3 residences  | None   |
| Through Wasco-Shafter | 2,307 residences, 9 churches, 6 schools, 1 park           | 1,176 residences, 11 churches, 1 school, 1 park, 2 historical        | Wasco-Shafter Bypass           | 506 residences, 1 school, 1 historical                                      | 90 residences  |
| Bakersfield North     | 5,940 residences, 17 churches, 8 schools, 4 parks         | 2,585 residences, 12 churches, 4 schools, 2 hospitals, 13 historical | Bakersfield South Alternative  | 5,737 residences, 18 churches, 8 schools, 1 hospital, 3 parks, 1 historical | 3,002 residences, 16 churches, 5 schools, 1 hospital, 2 parks, 12 historical |
|                       |   |  | Bakersfield Hybrid Alternative | 3,689 residences, 11 churches, 6 schools, 1 hospital, 4 historical,         | 1,474 residences, 1 church, 1 hospital, 1 park, 3 historical,                |

Source: Authority and FRA 2012.  
 Acronym:  
 NA Not Applicable

**Table 3.4-11**  
 Sensitive Noise Receivers Surrounding HMF Sites

| Heavy Maintenance Facility               | Within 900 feet |
|--|-----------------|
| Fresno Works-Fresno                      | 100 residences  |
| Kings County-Hanford                     | 6 residences    |
| Kern Council of Governments-Wasco        | 327 residences  |
| Kern Council of Governments-Shafter East | 6 residences    |
| Kern Council of Governments-Shafter West | 8 residences    |

Source: Authority and FRA 2012.

The receivers listed below are located within 175 feet of the rail centerline of project alternatives, and would be affected by vibration from the operation of the HST. These vibration effects would have substantial intensity under NEPA and the impact would be significant under CEQA. Vibration from HMF operations would not impact sensitive receptors at any of the alternative HMF sites.

- BNSF Alternative – 39 receivers.
- Hanford West Bypass 1 Alternative (At-Grade) – 4 receivers.
- Hanford West Bypass 1 Alternative (Below-Grade) – 2 receivers.
- Hanford West Bypass 2 Alternative (At-Grade) – 6 receivers.
- Hanford West Bypass 2 Alternative (Below-Grade) – 4 receivers.
- Corcoran Elevated Alternative – 0 receivers.
- Corcoran Bypass Alternative – 20 receivers.
- Allensworth Bypass Alternative – 1 receiver.
- Wasco-Shafter Bypass Alternative – 2 receivers.
- Bakersfield South Alternative – 14 receivers.
- Bakersfield Hybrid Alternative – 34 receivers

The schools listed below are the schools that were found to have a severe or moderate impact from the operation of the HST. A more detailed analysis was conducted for schools that were within 2,500 feet of the alternatives. Impacts were calculated for each of the 38 school sites individually that fell within the 2,500 feet. The schools that were found to have a moderate or severe impact—and the alternative that impacts them are listed below. These noise effects would have substantial intensity under NEPA and the impact would be significant under CEQA.

- Allensworth Elementary - BNSF
- Bessie E. Owens Intermediate – BNSF, Bakersfield South, and Bakersfield Hybrid
- Bethel Christian - BNSF, Bakersfield South, and Bakersfield Hybrid
- Blanton Education Center – BNSF and Bakersfield Hybrid
- College of the Sequoias – Hanford West Bypass 1 and Bypass 2 alternatives.
- Freewill Christian Academy - BNSF
- Fruitvale Junior High - BNSF, Bakersfield South, and Bakersfield Hybrid
- Mt. Vernon Elementary – Bakersfield South
- Sierra Pacific High School – Hanford West Bypass 1 and Bypass 2 alternatives.

#### 3.4.5.2 No Project Alternative

Currently, many sources of noise and vibration exist throughout the HST corridor, as described in Section 3.4.4, Affected Environment. These sources, including the UPRR, BNSF, and San Joaquin Valley Railroad will continue to generate noise and vibration.

Freight trains currently operating along the BNSF between Fresno and Bakersfield would continue to operate without the HST System. According to the FRA Office of Safety (2010), BNSF has maintained 20 to 24 trains per day for the past 10 years; 12 of these trains have been Amtrak trains. The number of trains is not anticipated to vary from this amount in the 20-year planning horizon. While there may be increases in freight volume, a 100% increase in volume would be required for a 3 dB increase in future freight noise levels. Because the increases in freight volumes would likely be substantially below 100%, the noise increases would be minimal.

People would continue to experience noise and vibrations throughout the study area; however, exposure of people to or the generation of significant noise or vibration levels would not change because local general plans and noise and vibration ordinances are in place to ensure that standards are met.

### 3.4.5.3 High-Speed Train Alternatives

#### Construction Period Impacts

##### *Impact N&V #1 - Construction Noise*

**Alternative Alignments.** By using the FTA criteria provided in Table 3.4-1 and the noise projections in Table 3.4-12, and assuming that construction noise reduces by 6 dB for each doubling of distance from the center of the site, it is possible to estimate the screening distances for potential construction noise impacts. These estimates suggest that the potential for construction noise impacts will be minimal for commercial and industrial land use, with impact screening distances of 79 feet and 45 feet, respectively. For residential land use, the potential for temporary construction noise impacts would be limited to locations within approximately 141 feet of the alignment. However, the potential for noise impacts from nighttime construction could extend to residences as far as 446 feet. These impacts are temporary during construction (see Chapter 2, Alternatives). Under these conditions potential noise effects would have moderate intensity under NEPA and impacts would be significant under CEQA.

During the construction phase, the UPRR tracks would be temporarily relocated in downtown Fresno near the proposed station area. The tracks would be moved approximately 150 feet west of their current location. Sensitive land use on this side of the tracks includes scattered single-family homes and a health clinic, and no impact is predicted for these receivers from future HST operations. Based on field measurements, the existing noise level in downtown Fresno near the UPRR tracks is approximately 70 dBA Ldn, 66 dBA Leq. Based on these levels, noise exposure would need to increase by more than 1 dB for Category 2 receivers (residences) and by 1.5 dB for Category 3 receivers (health clinic) to exceed the threshold for moderate noise impact. Noise exposure would need to increase by more than 3 dB for Category 2 receivers and by 3.5 dB for Category 3 receivers to exceed the threshold for severe noise impact. Assuming trains on the UPRR line are the dominant existing noise source, the temporary track relocation would move the tracks closer to the existing sensitive receivers. As a result of this reduction in distance to the tracks, there would be an increase in future noise levels of approximately 1 dB at the closest receiver. Therefore, there is only the potential for an impact of slightly moderate intensity due to this temporary construction measure. There would be no noise impact under NEPA from relocating UPRR tracks, and the impact would be less than significant under CEQA.

**HMF Sites.** By using the criteria provided in Table 3.4-1 and the noise projections in Table 3.4-12, and assuming that construction noise reduces by 6 dB for each doubling of distance from the center of the site, it is possible to estimate screening distances for potential construction noise impact. There are no construction noise impacts projected for any of the HMF sites.

**Schools.** By using the criteria provided in Table 3.4-1 and the noise projections in Table 3.4-12, and assuming that construction noise reduces by 6 dB for each doubling of distance from the center of the site, it is possible to estimate screening distances for potential construction noise impact. As there is only the potential for an impact of slightly moderate intensity due to temporary construction impacts to schools would be the same as all other sensitive receivers along the alignment. There are no construction noise impacts projected for any of the schools along the HST alternatives, because all schools are outside of the screening distances.

**Table 3.4-12**  
 Typical Equipment Noise for Rail Construction

| Equipment Item  | Typical Maximum Sound Level at 50 feet (dBA) | Equipment Utilization Factor (%) | L <sub>eq</sub> (dBA) |
|---|--|----------------------------------|-----------------------|
| Air compressor  | 81   | 50                               | 78                    |
| Backhoe   | 80   | 40                               | 76                    |
| Crane, derrick  | 88   | 10                               | 78                    |
| Bulldozer   | 85   | 40                               | 81                    |
| Generator   | 81   | 80                               | 80                    |
| Loader  | 85   | 40                               | 81                    |
| Jackhammer  | 88   | 4                                | 74                    |
| Shovel  | 82   | 40                               | 78                    |
| Dump truck  | 88   | 16                               | 80                    |
| <b>Total Workday L<sub>eq</sub> at 50 feet (8-hour workday)</b> |  |                                  | <b>89</b>             |
| Source: Authority and FRA 2012.                                 |  |                                  |                       |
| Acronyms:   |  |                                  |                       |
| dBA   | A-weighted decibel(s)                        |                                  |                       |
| L <sub>eq</sub>   | equivalent sound level                       |                                  |                       |

**Impact N&V #2 - Construction Vibration**

**Alternative Alignments.** During construction, some equipment may cause ground-borne vibrations, most notably pile-driving equipment. Pile-driving is only expected to occur where there is the need for a bridge, aerial structure, or road crossing; and is only one of the several proposed construction methods. Construction equipment can produce vibration levels at 25 feet that range from 58 VdB for a small bulldozer to 112 VdB for a pile driver. Table 3.4-13 provides the approximate distances within which receivers could experience construction vibration effects.

Because there are receivers present within the distances identified in Table 3.4-13, with pile driving, there is potential for severe vibration impacts during construction that would have substantial intensity under NEPA and would be significant under CEQA. Without pile driving, the impact would have moderate intensity under NEPA and would be less than significant under CEQA.

No vibration impact is predicted due to the temporary relocation of the UPRR tracks. Therefore, this relocation would not have an impact under NEPA, and the impact would be less than significant under CEQA.

**Table 3.4-13**  
 Approximate Distances to Vibration Criterion-Level Contours – Construction

| Land Use Category       | Vibration Criterion Level (VdB) | Approximate Vibration Contour Distance (feet) |
|-------------------------|---------------------------------|---|
| Category 1 <sup>a</sup> | 65                              | 175   |
| Category 2              | 72                              | 130   |
| Category 3              | 75                              | 70  |

Source: Authority and FRA 2012.  
 Note:  
<sup>a</sup> See Table 3.4-6 for a description of the categories.  
 Acronym:  
 VdB vibration velocity level

**HMF Sites.** There would be no vibration impacts from construction at any of the proposed HMF sites.

**Schools.** There would be no vibration impacts from construction to any of the schools along proposed HST alternatives.

**Project Impacts**

***Impact N&V #3 - Moderate and Severe Noise Impacts from Project Operation to Sensitive Receptors***

Project analysts assessed HST noise impacts for noise-sensitive land uses based on a comparison of existing noise levels with future noise levels from the project. The areas around the proposed stations in Fresno and Bakersfield are developed primarily with commercial and industrial land uses, with some residential land uses mixed in. The noise environments in these areas are dominated by traffic on the local streets, traffic on the freeways that surround the downtown areas, and train operations along rail lines. The Kings/Tulare Regional Station alternatives are located in rural areas where noise is dominated by traffic on SR 198 and local roads.

In rural areas where the alternative alignments are adjacent to the BNSF Railway, the measured ambient noise levels ranged from 64 to 77 dBA L<sub>dn</sub>. These noise levels are what would be expected in areas near freight and passenger train operations. Noise measurements made along the alignment through Corcoran ranged from 64 to 81 dBA L<sub>dn</sub>. These noise levels are consistent with what is expected for homes in the communities of Corcoran, Wasco, and Shafter adjacent to commercial and industrial sites that are exposed to highway traffic and railroad operations. Noise measurements made along the alignment through Hanford ranged from 48 to 76 dBA L<sub>dn</sub>. These levels are consistent with homes located in rural areas and near roadways with heavy truck traffic. In rural areas of the alternative alignments that are not adjacent to highways or railroads, noise may typically range from 47 to 63 dBA L<sub>dn</sub>.

Project noise levels for comparison depend on factors such as number of trains per day, speed, and track configuration. The conceptual operations schedule has up to 272 trains per day passing through Fresno and Bakersfield in 2035. The 2012 business plan anticipates a lower number of trains for the Initial Operating Segment and Phase 1, which would result in lower noise impacts for a period of time. The large number of homes along the alignment in Fresno, Corcoran, Wasco, Shafter, and Bakersfield, along with full system operations of high train speeds, would result in many noise impacts in the urban portions of the alignment alternatives before



mitigation. In the case of the Bakersfield Hybrid Alternative, train speeds would be reduced, resulting in fewer noise impacts to sensitive receivers than the BNSF and Bakersfield South alternatives for which design speeds would be maintained. In rural areas with low existing noise levels and no building shielding, impacts occur at greater distances from the alignment. All alternatives would result in severe and/or moderate noise impacts that would have substantial intensity under NEPA and would be significant under CEQA. Project elements, such as the specific vehicle type, track structure and other elements, may change during engineering and design, resulting in changes to the noise impact assessment. As project elements affecting noise either change or are refined, additional analyses will be conducted to reflect these changes.

The following sections summarize the potential noise impacts from the operation of the HST System. The *Fresno to Bakersfield Section: Noise and Vibration Technical Report* provides more details regarding impacts (Authority and FRA 2012).

**BNSF Alternative.** Table 3.4-14 summarizes potential direct noise impacts related to operation of the HST under the BNSF Alternative without mitigation during the design year (2035). Figures 3.4-9 through 3.4-13 show the locations of noise impacts under all HST alternative alignments without mitigation during the design year (2035). HST noise impacts are assessed for noise-sensitive land uses based on a comparison of existing noise levels with future noise levels from the project.

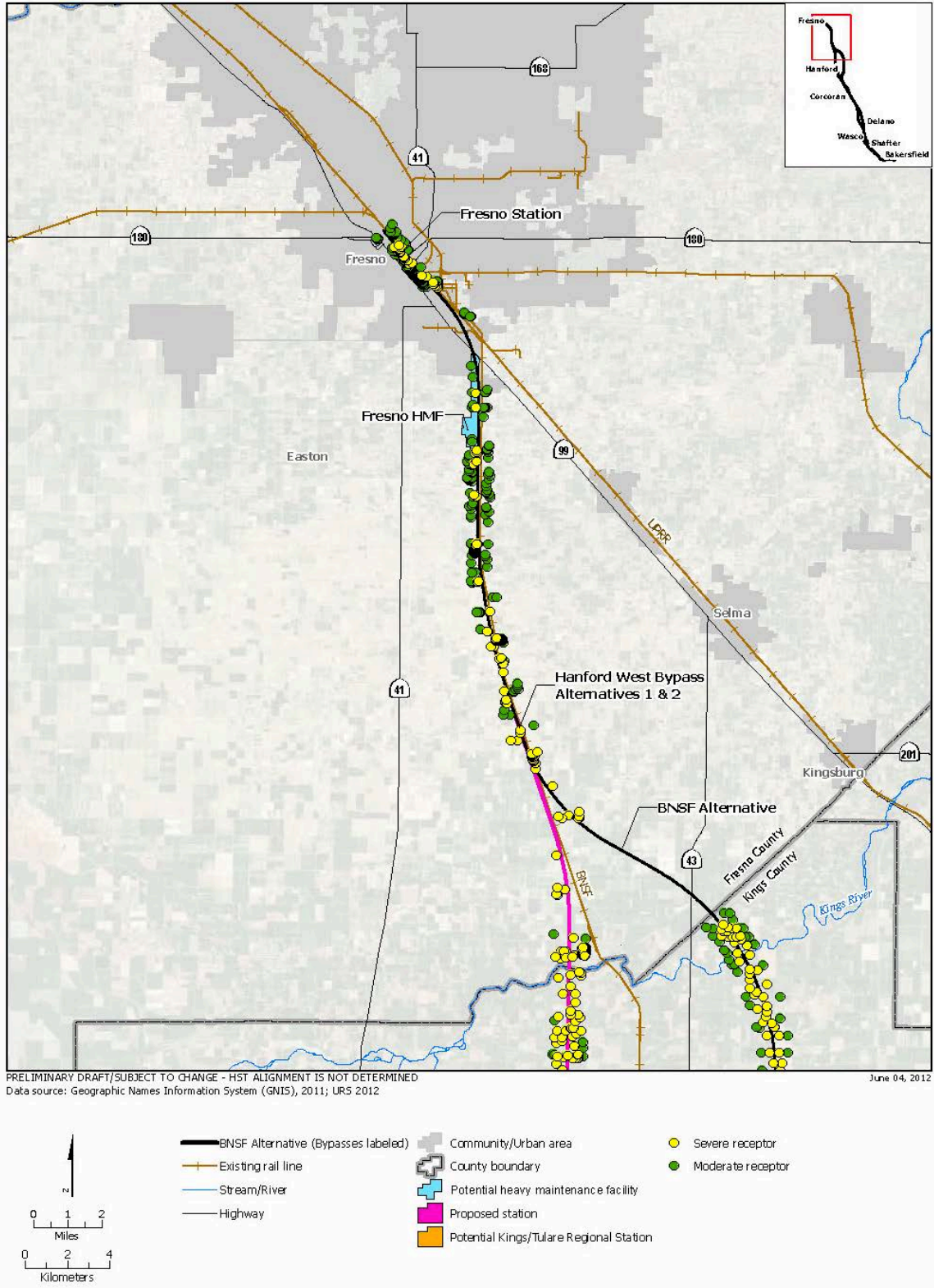
Project noise effects for many receivers along the BNSF Alternative before consideration of mitigation would have substantial intensity under NEPA and the impact would be significant under CEQA. Table 3.4-14 lists the number of sensitive receivers along the BNSF Alternative that may receive noise impacts from operation of the proposed project.

**Table 3.4-14**  
 Impacted Sensitive Noise Receivers along the BNSF Alternative

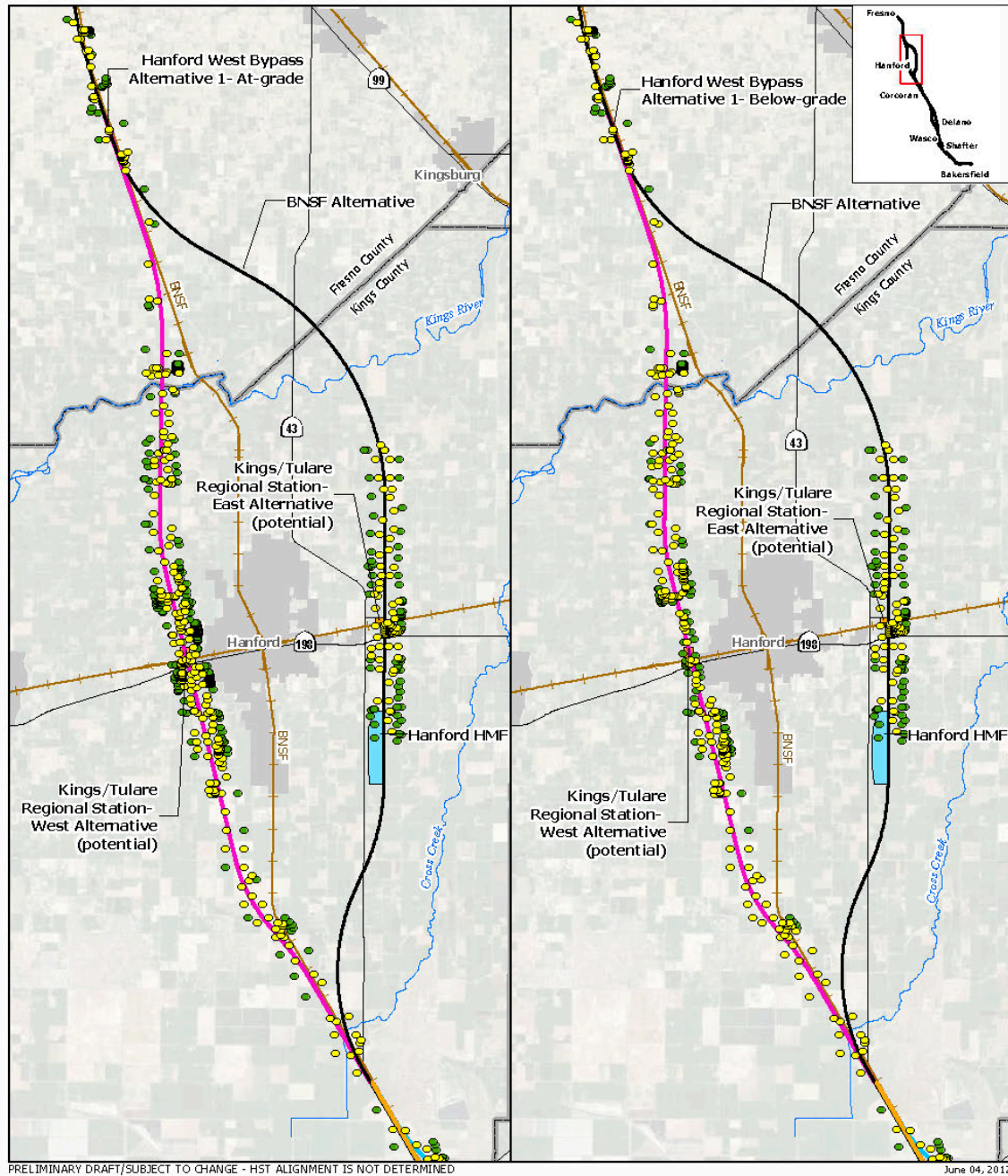
| BNSF Alternative   | Total Number of Impacts                           |  |
|--|---|--|
|  | Moderate Impacts                                  | Severe Impacts                         |
| <b>Impacts by Alignment Segment</b>  |   |  |
| BNSF Fresno<br>(Slab Track – Distance for Moderate Impact = 791 to 1,867 feet, Distance for Severe Impact = within 790 feet)<br>(Ballast Track – Distance for Moderate Impact = 511 to 1,270 feet, Distance for Severe Impact = within 510 feet)           | 201 residences, 7 churches, 1 park, 20 historical | 20 residences, 13 historical           |
| Monmouth<br>(Slab Track – Distance for Moderate Impact = 1,171 to 2,500 feet, Distance for Severe Impact = within 1,170 feet)<br>(Ballast Track – Distance for Moderate Impact = 761 to 1,860 feet, Distance for Severe Impact = within 760 feet)          | 115 residences, 3 schools, 2 historical           | 50 residences, 1 church                |
| BNSF Hanford East<br>(Slab – - Distance for Moderate Impact = 2,111 to 2,500 feet, Distance for Severe Impact = within 2,110 feet)<br>(Ballast Track – Distance for Moderate Impact = 1,421 to 2,500 feet, Distance for Severe Impact = within 1,420 feet) | 124 residences, 1 school                          | 176 residences, 1 school, 1 historical |

**Table 3.4-14**  
 Impacted Sensitive Noise Receivers along the BNSF Alternative

| BNSF Alternative   | Total Number of Impacts   |   |
|--|---|---|
|  | Moderate Impacts  | Severe Impacts  |
| BNSF Corcoran At-grade-West Side-C3<br>(Slab Track – Distance for Moderate Impact = 1,121 to 2,500 feet, Distance for Severe Impact = within 1,120 feet)<br>(Ballast Track – Distance for Moderate Impact = 731 to 1,780 feet, Distance for Severe Impact = within 730 feet) | 644 residences, 2 churches, 2 schools, 1 hospital, 1 park                             | 419 residences, 1 church, 1 park, 1 historical  |
| Pixley<br>(Slab Track – Distance for Moderate Impact = 1,231 to 2,500 feet, Distance for Severe Impact = within 1,230 feet)<br>(Ballast Track – Distance for Moderate Impact = 811 to 1,960 feet, Distance for Severe Impact = within 810 feet)                              | None  | 2 residences  |
| BNSF Allensworth A2<br>(Slab Track – Distance for Moderate Impact = 1,131 to 2,500 feet, Distance for Severe Impact = within 1,130 feet)<br>(Ballast Track – Distance for Moderate Impact = 741 to 1,810 feet), (Distance for Severe Impact = within 740 feet)               | 32 residences, 1 school   | 12 residences, 1 park, 1 historical   |
| BNSF Wasco-Shafter WS1<br>(Slab Track – Distance for Moderate Impact = 1,151 to 2,500 feet), (Distance for Severe Impact = within 1,150 feet)<br>(Ballast Track – Distance for Moderate Impact = 711 to 1,950 feet, Distance for Severe Impact = within 710 feet)            | 2,307 residences, 9 churches, 6 schools, 1 park                                       | 1,176 residences, 11 churches, 1 school, 1 park, 2 historical                         |
| Bakersfield B1<br>(Slab Track – Distance for Moderate Impact = 1,141 to 2,500 feet, Distance for Severe Impact = within 1,140 feet)<br>(Ballast Track – Distance for Moderate Impact = 641 to 2,030 feet), (Distance for Severe Impact = within 640 feet)                    | 5,940 residences, 17 churches, 8 schools, 4 parks                                     | 2,585 residences, 12 churches, 4 schools, 2 hospitals, 13 historical                  |
| <b>Total Impacts under the BNSF Alternative</b>  | <b>9,363 residences, 35 churches, 21 schools, 1 hospital, 7 parks, 22 historical,</b> | <b>4,440 residences, 25 churches, 6 schools, 2 hospitals, 3 parks, 31 historical,</b> |
| Source: Authority and FRA 2012.  |   |   |

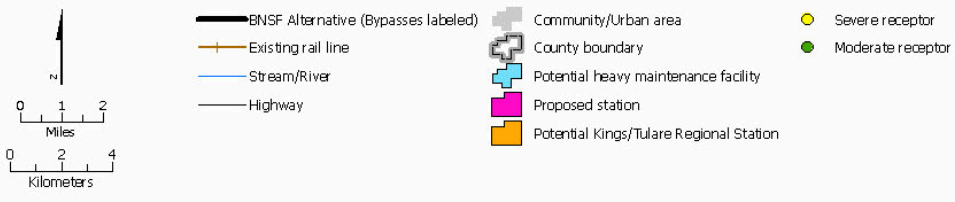


**Figure 3.4-9**  
 Fresno area: Noise impacts

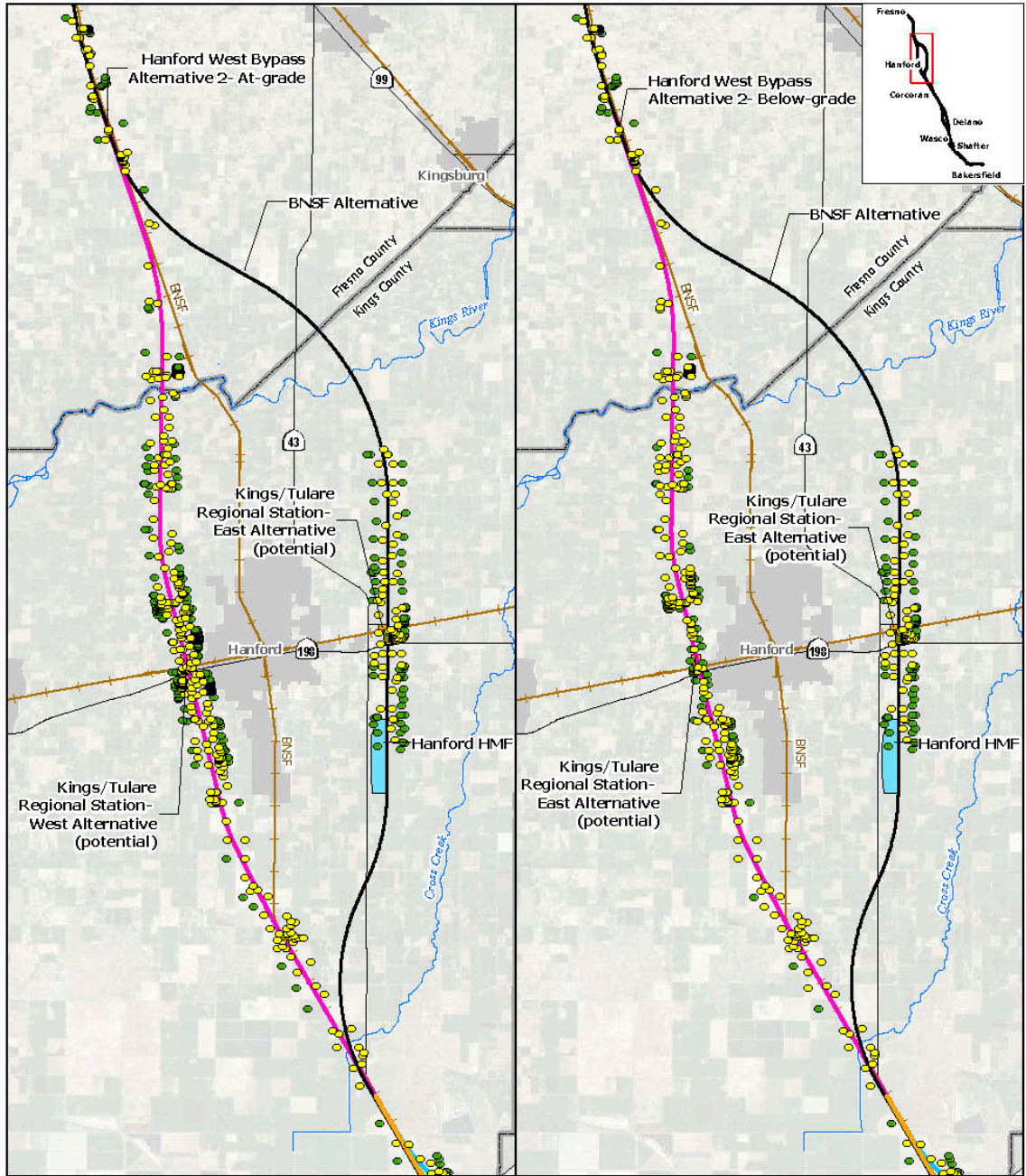


PRELIMINARY DRAFT/SUBJECT TO CHANGE - HST ALIGNMENT IS NOT DETERMINED  
 Data source: Geographic Names Information System (GNIS), 2011; URS 2012

June 04, 2012

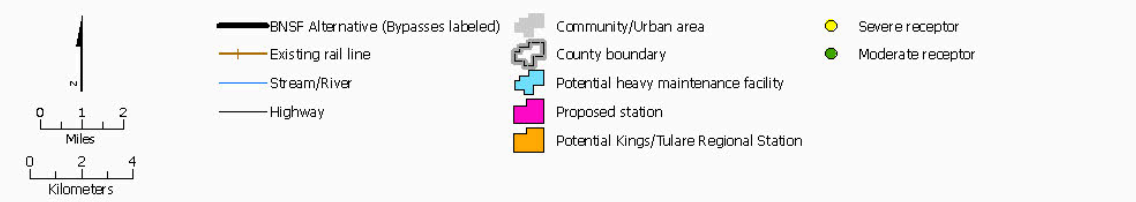


**Figure 3.4-10**  
 Hanford / Alt 1 area: Noise impacts

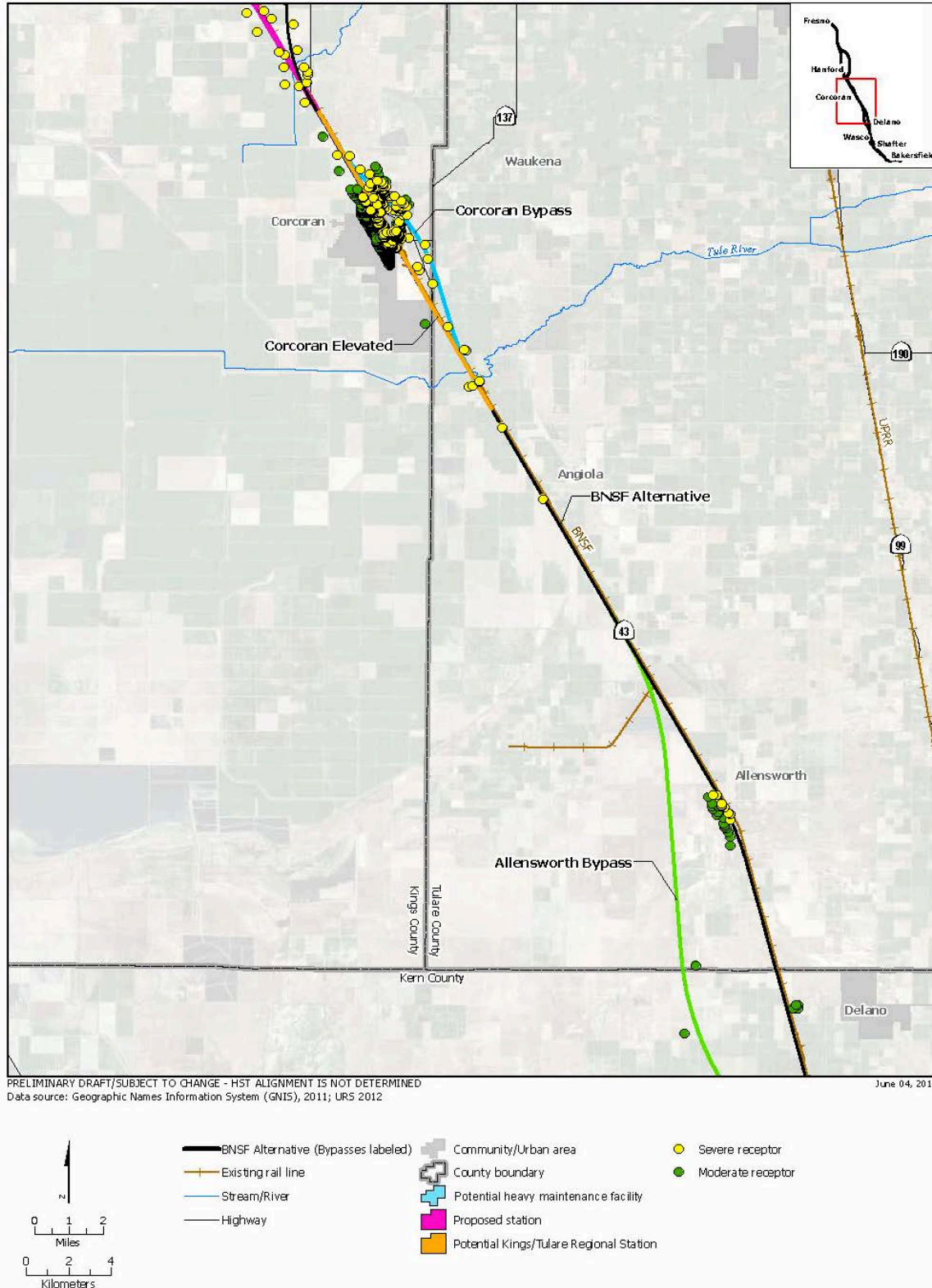


PRELIMINARY DRAFT/SUBJECT TO CHANGE - HST ALIGNMENT IS NOT DETERMINED  
 Data source: Geographic Names Information System (GNIS), 2011; URS 2012

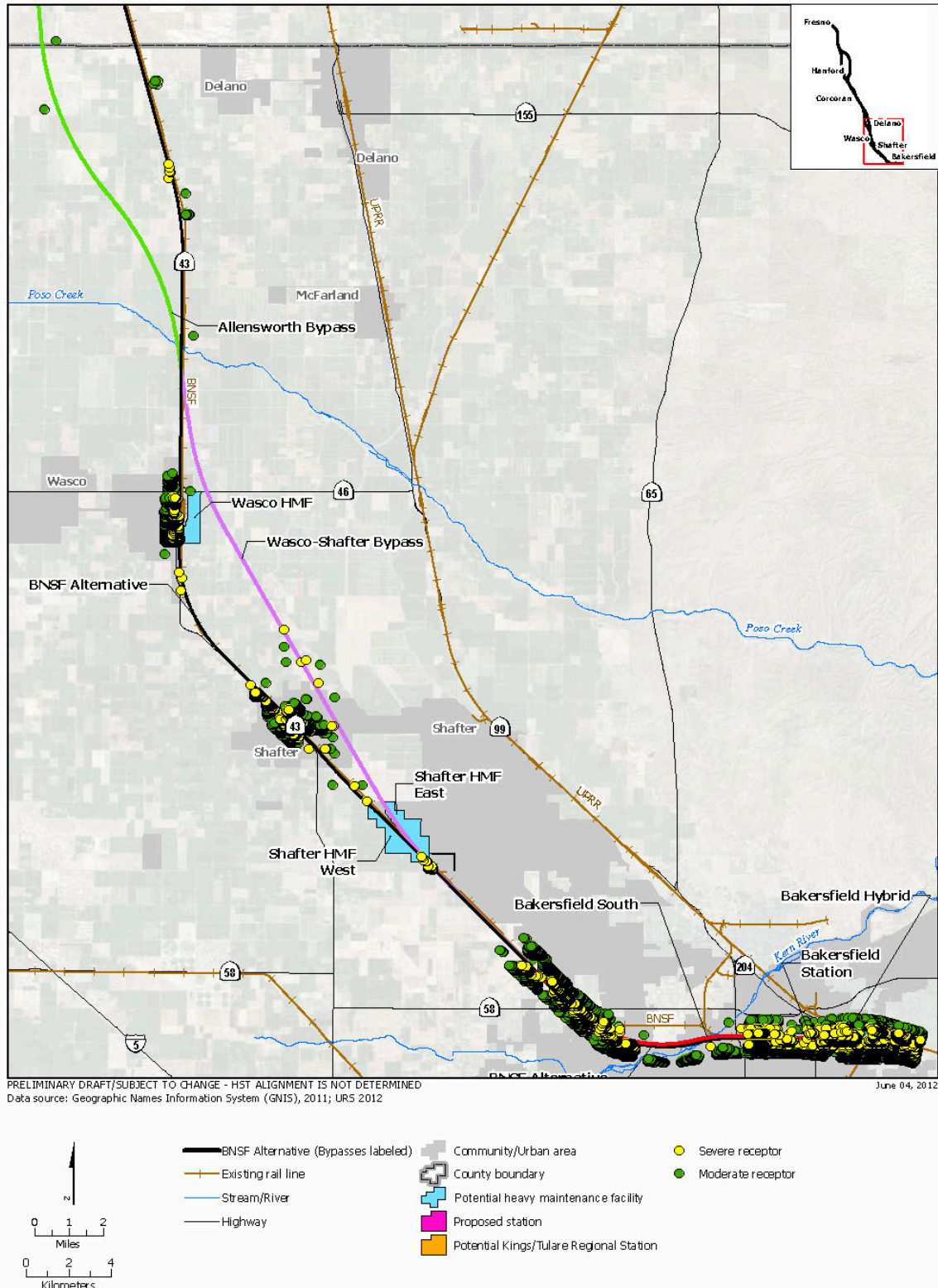
June 04, 2012



**Figure 3.4-11**  
 Hanford / Alt 2 area: Noise impacts



**Figure 3.4-12**  
 Corcoran area: Noise impacts



**Figure 3.4-13**  
 Bakersfield area: Noise impacts

Appendix 3.4-A NV Tables 4 and 5 show the potential noise impacts from the BNSF Alternative without mitigation for the design year (2035) at each of the locations where existing noise measurements were conducted. These two tables show the measurement sites and the distance from the receiver to the BNSF Alternative. These two tables also show the source height, land use type, measured existing noise level, projected HST noise level, and the moderate and severe impact criteria. The projected HST noise level is compared with the impact criteria to determine the locations with impacts. Finally, the two tables show the total noise level with the project, the projected noise level increase with the project, where there is no impact, and where noise would have moderate or severe intensity due to the HST project.

**Hanford West Bypass 1 Alternative.** Noise effects before consideration of mitigation for many of the receivers along the Hanford West Bypass 1 Alternative would have substantial intensity under NEPA and the impact would be significant under CEQA. Tables 3.4-15 and 3.4-16 list the number of sensitive receivers along the Hanford West Bypass 1 Alternative – At-Grade and Hanford West Bypass 1 Alternative – Below Grade, respectively, that may receive moderate or severe noise impacts from operation of the proposed project. Appendix 3.4-A NV, Tables 6 through 9, list the potential noise impacts under these two options of the Hanford West Bypass 1 Alternative without mitigation for the design year (2035) at each of the locations where existing noise measurements were conducted.

**Table 3.4-15**  
 Noise Impacts for Hanford West Bypass 1 Alternative – At-Grade

| HST Alternative  | Total Number of Impacts before Mitigation      |   |
|--|--|---|
|  | Moderate                                       | Severe  |
| Hanford West Bypass 1 Alternative<br>(At-Grade)<br>(Slab Track – Distance for Moderate Impact = 1,628 to 2,500 feet, Distance for Severe Impact = within 1,627 feet) | 382 residences, 1 school, 1 park, 1 historical | 226 residences, 2 schools, 1 park, 3 historical |
| Source: Authority and FRA 2012.  |  |   |

**Table 3.4-16**  
 Noise Impacts for Hanford West Bypass 1 Alternative – Below Grade

| HST Alternative   | Total Number of Impacts before Mitigation |                                      |
|---|---|--------------------------------------|
|   | Moderate                                  | Severe                               |
| Hanford West Bypass 1 Alternative<br>(Below Grade)<br>(Slab Track – Distance for Moderate Impact = 1,961 to 2,500 feet, Distance for Severe Impact = 1,960 within feet)<br>(Ballast Track – Distance for Moderate Impact = 443 to 1,100 feet, Distance for Severe Impact = 442 within feet) | 162 residences, 2 schools, 1 park         | 227 residences, 1 park, 3 historical |
| Source: Authority and FRA 2012.   |   |                                      |



**Hanford West Bypass 2 Alternative.** Noise effects before consideration of mitigation for many of the receivers along the Hanford West Bypass 2 Alternative would have substantial intensity under NEPA and the impact would be significant under CEQA. Tables 3.4-17 and 3.4-18 list the number of sensitive receivers along the Hanford West Bypass 2 Alternative – At-Grade and Hanford West Bypass 2 Alternative – Below Grade, respectively, that may receive moderate or severe noise impacts from operation of the proposed project. Appendix 3.4-A NV, Tables 10 through 13, list the potential noise impacts under these two options of the Hanford West Bypass 2 Alternative without mitigation for the design year (2035) at each of the locations where existing noise measurements were conducted.

**Table 3.4-17**  
 Noise Impacts for Hanford West Bypass 2 Alternative – At-Grade

| HST Alternative   | Total Number of Impacts before Mitigation      |   |
|---|--|---|
|   | Moderate                                       | Severe  |
| Hanford West Bypass 2 Alternative (At-Grade)  |  |   |
| (Slab Track – Distance for Moderate Impact = 1,689 to 2,500 feet, Distance for Severe Impact = within 1,688 feet) | 363 residences, 1 school, 1 park, 2 historical | 247 residences, 2 schools, 1 park, 2 historical |
| Source: Authority and FRA 2012.   |  |   |

**Table 3.4-18**  
 Noise Impacts for Hanford West Bypass 2 Alternative – Below Grade

| HST Alternative  | Total Number of Impacts before Mitigation |  |
|--|---|--|
|  | Moderate                                  | Severe   |
| Hanford West Bypass 2 Alternative (Below Grade)  |   |  |
| (Slab Track – Distance for Moderate Impact = 2,149 to 2,500 feet, Distance for Severe Impact = within 2,148 feet)  | 109 residences, 1 school, 1 park          | 282 residences, 1 school, 1 park, 3 historical |
| (Ballast Track – Distance for Moderate Impact = 443 to 1,100 feet), (Distance for Severe Impact = within 442 feet) |   |  |
| Source: Authority and FRA 2012.  |   |  |

**Corcoran Elevated.** Noise effects before consideration of mitigation for many of the receivers along the Corcoran Elevated Alternative would have substantial intensity under NEPA and the impact would be significant under CEQA. Table 3.4-19 lists the number of sensitive receivers along this alternative that may have moderate or severe noise impacts from operation of the proposed project. There are 31 additional receivers that would be severely impacted by noise and 102 additional receivers that would be moderately impacted by noise with the Corcoran Elevated Alternative, compared with the corresponding segment of the BNSF Alternative. Appendix 3.4-A NV, Tables 14 and 15, list the potential noise impacts under the Corcoran Elevated Alternative

without mitigation for the design year (2035) at each of the locations where existing noise measurements were conducted.

**Table 3.4-19**  
 Sensitive Noise Receivers along the Corcoran Elevated Alternative

| Section   | Moderate Impacts  | Severe Impacts                                 |
|---|---|--|
| Corcoran Elevated Alternative   |   |  |
| (Slab Track – Distance for Moderate Impact = 1,051 to 2,500 feet; Distance for Severe Impact = within 1,050 feet) | 745 residences, 2 churches, 3 schools, 1 hospital, 1 park | 450 residences, 1 church, 1 park, 1 historical |
| (Ballast Track – Distance for Moderate Impact = 661 to 1,740 feet; Distance for Severe Impact = within 660 feet)  |   |  |
| Source: Authority and FRA 2012.   |   |  |

**Corcoran Bypass Alternative.** Noise effects before consideration of mitigation for many of the receivers along the Corcoran Bypass Alternative would have substantial intensity under NEPA and the impact would be significant under CEQA. Table 3.4-20 lists the number of sensitive receivers along this alternative that may receive moderate or severe noise impacts from operation of the proposed project. There are 311 fewer receivers that would be severely impacted by noise and 554 fewer receivers that would be moderately impacted by noise with the Corcoran Bypass Alternative, compared with the corresponding segment of the BNSF Alternative. Appendix 3.4-A NV, Tables 16 and 17, list the potential noise impacts under the Corcoran Bypass Alternative without mitigation for the design year (2035) at each of the locations where existing noise measurements were conducted.

**Table 3.4-20**  
 Sensitive Noise Receivers along the Corcoran Bypass Alternative

| Section  | Moderate Impacts | Severe Impacts           |
|--|------------------|--------------------------|
| Corcoran Bypass Alternative  |                  |                          |
| (Slab Track – Distance for Moderate Impact = 2,111 to 2,500 feet; Distance for Severe Impact = within 2,110 feet)    | 96 residences    | 110 residences, 1 school |
| (Ballast Track – Distance for Moderate Impact = 1,451 to 2,500 feet; Distance for Severe Impact = within 1,450 feet) |                  |                          |
| Source: Authority and FRA 2012.  |                  |                          |

**Allensworth Bypass Alternative.** Noise effects before consideration of mitigation for 8 residences along the Allensworth Bypass Alternative would have moderate intensity under NEPA, and the impact would be less than significant under CEQA (Table 3.4-21). There are 14 fewer receivers that would be severely impacted by noise and 30 fewer receivers that would be moderately impacted by noise with this alternative, compared with the corresponding segment of the BNSF Alternative. Appendix 3.4-A NV Tables 18 and 19 list the potential noise impacts under the Allensworth Bypass Alternative without mitigation for the design year (2035) at each of the locations where existing noise measurements were conducted.

**Table 3.4-21**  
 Sensitive Noise Receivers along the Allensworth Bypass Alternative

| Section  | Moderate Impacts | Severe Impacts |
|--|------------------|----------------|
| Allensworth Bypass Alternative   |                  |                |
| (Slab Track – Distance for Moderate Impact = 1,581 to 2,500 feet; Distance for Severe Impact = within 1,580 feet)    | 3 residences     | None           |
| (Ballast Track – Distance for Moderate Impact = 1,061 to 2,500 feet; Distance for Severe Impact = within 1,060 feet) |                  |                |
| Source: Authority and FRA 2012.  |                  |                |

**Wasco-Shafter Bypass Alternative.** Noise effects before consideration of mitigation for many receivers along the Wasco-Shafter Bypass Alternative would have substantial intensity under NEPA and the impact would be significant under CEQA. Table 3.4-22 lists the number of sensitive receivers along this alternative alignment that may receive moderate or severe noise impacts from operation of the proposed project. There are 1,101 fewer receivers that would be severely impacted and 1,815 fewer receivers that would be moderately impacted by the Wasco-Shafter Bypass Alternative, compared with the corresponding segment of the BNSF Alternative. Appendix 3.4-A NV Tables 20 and 21 list the potential noise impacts under the Wasco-Shafter Bypass Alternative without mitigation for the design year (2035) at each of the locations where existing noise measurements were conducted.

**Table 3.4-22**  
 Sensitive Noise Receivers along the Wasco-Shafter Bypass Alternative

| Section  | Moderate Impacts                       | Severe Impacts |
|--|--|----------------|
| Wasco-Shafter Bypass Alternative   |  |                |
| (Slab Track – Distance for Moderate Impact = 1,511 to 2,500 feet; Distance for Severe Impact = within 1,510 feet)    | 506 residences, 1 school, 1 historical | 90 residences  |
| (Ballast Track – Distance for Moderate Impact = 1,011 to 2,410 feet; Distance for Severe Impact = within 1,010 feet) |  |                |
| Source: Authority and FRA 2012.  |  |                |

**Bakersfield South Alternative.** Noise effects before consideration of mitigation for many receivers along the Bakersfield South Alternative would have substantial intensity under NEPA and the impact would be significant under CEQA. Table 3.4-23 lists the number of sensitive receivers along this alternative alignment that may receive moderate or severe noise impacts from operation of the proposed project. There are an additional 422 receivers that would be severely impacted and 201 fewer receivers that would be moderately impacted by the Bakersfield South Alternative, compared with the corresponding segment of the BNSF Alternative. Appendix 3.4-A NV Tables 22 and 23 list the potential noise impacts under the Bakersfield South Alternative without mitigation for the design year (2035) at each of the locations where existing noise measurements were conducted.

**Table 3.4-23**  
 Sensitive Noise Receivers along the Bakersfield South Alternative

| Section   | Moderate Impacts  | Severe Impacts   |
|---|---|--|
| Bakersfield South Alternative   |   |  |
| (Slab Track – Distance for Moderate Impact = 1,091 to 2,500 feet; Distance for Severe Impact = within 1,090 feet) | 5,737 residences, 18 churches, 8 schools, 1 hospital, 3 parks, 1 historical | 3,002 residences, 16 churches, 5 schools, 1 hospital, 2 parks, 12 historical |
| (Ballast Track – Distance for Moderate Impact = 611 to 1,990 feet; Distance for Severe Impact = within 610 feet)  |   |  |
| Source: Authority and FRA 2012.   |   |  |

**Bakersfield Hybrid Alternative.** Noise effects before consideration of mitigation for many receivers along the Bakersfield Hybrid Alternative would have substantial intensity under NEPA and the impact would be significant under CEQA. Table 3.4-24 lists the number of sensitive receivers along this alternative alignment that may receive moderate or severe noise impacts from operation of the proposed project. There are 1,136 fewer receivers that would be severely impacted and 2,258 fewer receivers that would be moderately impacted by the Bakersfield South Alternative, compared with the corresponding segment of the BNSF Alternative. Appendix 3.4-A NV, Tables 24 and 25, list the potential noise impacts under the Bakersfield Hybrid Alternative without mitigation for the design year (2035) at each of the locations where existing noise measurements were conducted.

**Table 3.4-24**  
 Sensitive Noise Receivers along the Bakersfield Hybrid Alternative

| Section   | Moderate Impacts  | Severe Impacts  |
|---|---|---|
| Bakersfield South Alternative   |   |   |
| (Slab Track – Distance for Moderate Impact = 1,372 to 2,500 feet; Distance for Severe Impact = within 1,371 feet) | 3,689 residences, 11 churches, 6 schools, 1 hospital, 4 historical, | 1,474 residences, 1 church, 1 hospital, 1 park, 3 historical, |
| (Ballast Track – Distance for Moderate Impact = 853 to 2,073 feet; Distance for Severe Impact = within 852 feet)  |   |   |
| Source: Authority and FRA 2012.   |   |   |

**HMF Sites.** According to the noise standards listed in the California Noise and Land Use Capability Matrix, it is normally acceptable for industrial land uses to generate noise levels as high as 75 dBA at 50 feet from the noise source. If a noise level of this magnitude was generated at the selected HMF sites, then for noise levels to be below 50 dBA, a receiver would need to be at least 900 feet from the noise source. Table 3.4-11 (above) lists the number of sensitive receivers within 900 feet of each proposed heavy maintenance facility site that would have severe impacts according to the FRA impact criteria. Each HMF has residences within the 900-foot contour line and therefore noise effects from HMF operations at all the alternative HMF sites would have substantial intensity under NEPA, and the impact would be significant under CEQA.

**Schools.** A more detailed analysis was conducted for impacts to schools within 2,500 feet of the alignments. All schools that were found to be within the 2,500 foot screening distance were individually analyzed. Therefore, other factors that were not used in calculate the screening distances, such as changes in the existing ambient noise level at each site were utilized for the

specific school analysis. The result was a decrease in the number of schools that would experience moderate and severe impacts. When using the screening distances, 27 schools were estimated to have a severe or moderate impact from the operation of the BNSF Alternative; however, in conducting the detailed analysis for the BNSF Alternative it was found that only 6 schools are expected to receive a severe or moderate impact (1 severe and 5 moderate). Those schools are listed below, along with the impacts for all alternatives. These noise effects would have substantial intensity under NEPA, and the impact would be significant under CEQA.

**Table 3.4-25**  
 Impacts to Schools by Alternative

| School Name                             | Existing Noise Exposure (Leq) | Total Level Unmitigated (Leq) | FRA Impact No Mitigation |
|---|-------------------------------|-------------------------------|--------------------------|
| <b>BNSF Alternative</b>                 |                               |                               |                          |
| Lincoln Elementary                      | 65                            | 66                            | None                     |
| Pacific Union Elementary                | 61                            | 65                            | None                     |
| Monroe Elementary                       | 64                            | 66                            | None                     |
| Riverdale School                        | 60                            | 64                            | None                     |
| John Muir Middle                        | 62                            | 66                            | None                     |
| Allensworth Elementary                  | 51                            | 62                            | Moderate                 |
| John C Fremont Elementary               | 62                            | 65                            | None                     |
| Redwood Elementary/Richland Junior High | 71                            | 72                            | None                     |
| Freewill Christian Academy              | 61                            | 66                            | Moderate                 |
| Bethany Christian                       | 69                            | 70                            | None                     |
| St. John the Evangelist School          | 67                            | 68                            | None                     |
| Central Valley High (Continuation)      | 68                            | 69                            | None                     |
| Shafter High                            | 68                            | 69                            | None                     |
| Karl F. Clemens Elementary              | 67                            | 68                            | None                     |
| Bethel Christian                        | 64                            | 69                            | Moderate                 |
| Bessie E. Owens Intermediate            | 60                            | 71                            | Severe                   |
| Warriors for Christ Academy             | 69                            | 72                            | None                     |
| Blanton Education Center                | 63                            | 68                            | Moderate                 |
| Rafer Johnson Childrens Center          | 64                            | 66                            | None                     |
| Country Christian School, Inc.          | 64                            | 66                            | None                     |
| Columbia Elementary                     | 69                            | 70                            | None                     |
| Fruitvale Junior High                   | 58                            | 64                            | Moderate                 |
| J. C. Worthy Institute                  | 60                            | 63                            | None                     |
| Rosedale-North Elementary               | 60                            | 63                            | None                     |
| William Penn Elementary                 | 63                            | 66                            | None                     |
| Downtown Elementary                     | 68                            | 69                            | None                     |
| Caroline Harris Elementary              | 66                            | 68                            | None                     |
| Stockdale Christian Elementary          | 66                            | 68                            | None                     |

**Table 3.4-25**  
**Impacts to Schools by Alternative**

| School Name  | Existing Noise Exposure (Leq) | Total Level Unmitigated (Leq) | FRA Impact No Mitigation |
|--|-------------------------------|-------------------------------|--------------------------|
| Independence Elementary                                | 64                            | 65                            | None                     |
| Bakersfield High                                       | 70                            | 72                            | None                     |
| Franklin Elementary                                    | 69                            | 70                            | None                     |
| Our Lady of Guadalupe School                           | 74                            | 74                            | None                     |
| Sierra Middle  | 71                            | 72                            | None                     |
| Ramon Gorza Elementary                                 | 71                            | 72                            | None                     |
| <b>Hanford West Bypass 1 Alternative – At-Grade</b>    |                               |                               |                          |
| College of the Sequoias                                | 56                            | 68                            | Severe                   |
| Sierra Pacific High                                    | 56                            | 65                            | Moderate                 |
| Frontier Elementary                                    | 61                            | 61                            | None                     |
| <b>Hanford West Bypass 1 Alternative – Below-Grade</b> |                               |                               |                          |
| College of the Sequoias                                | 56                            | 61                            | Moderate                 |
| Sierra Pacific High                                    | 56                            | 63                            | Moderate                 |
| Frontier Elementary                                    | 61                            | 61                            | None                     |
| <b>Hanford West Bypass 2 Alternative – Below-Grade</b> |                               |                               |                          |
| College of the Sequoias                                | 56                            | 68                            | Severe                   |
| Sierra Pacific High                                    | 56                            | 65                            | Moderate                 |
| Frontier Elementary                                    | 61                            | 61                            | None                     |
| <b>Hanford West Bypass 2 Alternative – At-Grade</b>    |                               |                               |                          |
| College of the Sequoias                                | 56                            | 61                            | Moderate                 |
| Sierra Pacific High                                    | 56                            | 63                            | Moderate                 |
| Frontier Elementary                                    | 61                            | 61                            | None                     |
| <b>Corcoran Elevated Alternative</b>                   |                               |                               |                          |
| Riverdale School                                       | 60                            | 64                            | None                     |
| John Muir Middle                                       | 62                            | 66                            | None                     |
| John C Fremont Elementary                              | 62                            | 64                            | None                     |
| <b>Corcoran Bypass Alternative</b>                     |                               |                               |                          |
| Riverdale School                                       | 60                            | 64                            | None                     |
| <b>Bakersfield South Alternative</b>                   |                               |                               |                          |
| Bessie E. Owens Intermediate                           | 60                            | 68                            | Moderate                 |
| Bethel Christian                                       | 64                            | 69                            | Moderate                 |
| Fruitvale Junior High                                  | 58                            | 64                            | Moderate                 |
| Mt. Vernon Elementary                                  | 59                            | 66                            | Moderate                 |
| Bakersfield High                                       | 70                            | 71                            | None                     |
| Blanton Education Center                               | 63                            | 66                            | None                     |

**Table 3.4-25**  
**Impacts to Schools by Alternative**

| School Name                           | Existing Noise Exposure (Leq) | Total Level Unmitigated (Leq) | FRA Impact No Mitigation |
|---------------------------------------|-------------------------------|-------------------------------|--------------------------|
| Columbia Elementary                   | 69                            | 70                            | None                     |
| Country Christian School, Inc.        | 64                            | 66                            | None                     |
| Downtown Elementary                   | 68                            | 69                            | None                     |
| Franklin Elementary                   | 69                            | 71                            | None                     |
| Independence Elementary               | 64                            | 65                            | None                     |
| J. C. Worthy Institute                | 60                            | 63                            | None                     |
| Our Lady of Guadalupe School          | 74                            | 75                            | None                     |
| Rafer Johnson Childrens Center        | 64                            | 66                            | None                     |
| Rosedale-North Elementary             | 60                            | 63                            | None                     |
| Ramon Gorza Elementary                | 71                            | 72                            | None                     |
| Sierra Middle                         | 71                            | 72                            | None                     |
| Warriors for Christ Academy           | 69                            | 72                            | None                     |
| William Penn Elementary               | 63                            | 66                            | None                     |
| <b>Bakersfield Hybrid Alternative</b> |                               |                               |                          |
| Bessie E. Owens Intermediate          | 60                            | 69                            | Moderate                 |
| Bethel Christian                      | 64                            | 69                            | Moderate                 |
| Blanton Education Center              | 63                            | 69                            | Moderate                 |
| Fruitvale Junior High                 | 58                            | 64                            | Moderate                 |
| Bakersfield High                      | 70                            | 71                            | None                     |
| Columbia Elementary                   | 69                            | 70                            | None                     |
| Country Christian School, Inc.        | 64                            | 66                            | None                     |
| Downtown Elementary                   | 68                            | 69                            | None                     |
| Independence Elementary               | 64                            | 65                            | None                     |
| Franklin Elementary                   | 70                            | 71                            | None                     |
| J. C. Worthy Institute                | 60                            | 63                            | None                     |
| Our Lady of Guadalupe School          | 74                            | 74                            | None                     |
| Rafer Johnson Childrens Center        | 64                            | 67                            | None                     |
| Ramon Gorza Elementary                | 71                            | 72                            | None                     |
| Rosedale-North Elementary             | 60                            | 63                            | None                     |
| Sierra Middle                         | 71                            | 72                            | None                     |
| Warriors for Christ Academy           | 69                            | 72                            | None                     |
| William Penn Elementary               | 63                            | 66                            | None                     |
| Williams Elementary                   | 66                            | 68                            | None                     |
| Source: Authority and FRA 2012.       |                               |                               |                          |

### **Annoyance from Onset of HST Pass-bys**

There is considerable evidence that increased annoyance is likely to occur for train noise events with rapid onset rates. The relationship between speed and distance defines the locations where the onset rate for HST operations can cause annoyance or surprise according to the FRA guidance manual (FRA 2005). For the most part, the potential for increased annoyance is confined to an area very close to the tracks. In the Fresno to Bakersfield Section, the maximum train speeds would be 220 mph. At this speed, the distance from the centerline of the tracks within which annoyance or surprise can occur would be 45 feet, which is within the project right-of-way where people and animals will be excluded with fencing. For these reasons, rapid onset noise events are considered to have an effect of negligible intensity under NEPA, and a less than significant impact under CEQA.

### ***Impact N&V #4 - Noise Effects on Wildlife and Domestic Animals***

FRA also addresses the impacts of the HST on wildlife (mammals and birds) and domestic animals (livestock and poultry). The noise exposure limit for each type of animal is an SEL of 100 dBA from passing trains. The SEL represents a receiver's cumulative noise exposure from an event and represents the total A-weighted sound during the event normalized to a 1-second interval.

A screening assessment determined typical and maximum distances from the HST tracks at which this limit may be exceeded. Project analysts computed train pass-by SELs for two conditions: at-grade and on a 60-foot-high elevated guideway. To provide a conservative estimate, in each case the HST maximum operating speed of 220 mph was used, and no shielding from intervening structures or terrain was assumed.

Table 3.4-26 indicates that along at-grade sections, the screening distance (i.e., distance from trackway centerline within which an impact could result) for a single-train pass-by SEL of 100 dBA would be approximately 100 feet from the track centerline. In elevated guideway locations, a single-train pass-by SEL of 100 dBA would not occur beyond the edge of the structure, approximately 15 feet from the track centerline. This assumes the presence of a safety barrier on the edge of the guideways that is 3 feet above the top of the rail height, as detailed in typical cross sections.

For reference, Table 3.4-26 also shows the screening distances for potential wildlife/domestic animal impacts from freight trains that currently use the UPRR and BNSF tracks. The distance to an impact for a freight train is 75 feet when the warning horn is not sounded and 400 feet when the crossing is at-grade and the horn is sounded. These screening distances assume a freight train consisting of two locomotives and 100 railcars traveling at 50 mph, which is typical for trains on the UPRR and BNSF tracks.

According to the screening distance information provided in Table 3.4-26, wildlife and domestic animals might be within the screening distance for an at-grade HST (i.e., within 100 feet in both directions from the track centerline [for a total width of 200 feet]). Because fences control access to the right-of-way and the right-of-way would be 100 feet wide in rural locations, wildlife and domestic animals would have to be within approximately 50 feet of the edge of the right-of-way to experience noise effects above the recommended threshold. This issue would primarily occur where wildlife migration routes cross the HST right-of-way along at-grade locations. At locations adjacent to the UPRR, BNSF, or SR 99 where the existing noise is already high, there would be no effects under NEPA and no impacts under CEQA. However, in rural areas there could be impacts. These impacts are discussed in Section 3.7, Biological Resources and Wetlands, and Section 3.14, Agricultural Lands.



**Table 3.4-26**  
 Screening Distances for Effects on Wildlife and Domestic Animals

| Track Location                                 | Speed (mph) | SEL <sup>a</sup> (dBA) | Distance from Trackway Centerline Where Impacts Could Result (feet) |
|--|-------------|------------------------|---|
| HST at-grade                                   | 220         | 100                    | 100   |
| HST 60-foot-high elevated structure            | 220         | 100                    | 15 <sup>b</sup>   |
| Freight train, no horn noise                   | 50          | 100                    | 75  |
| Freight train, sounding horn at-grade crossing | 50          | 100                    | 400   |

Source: Authority and FRA 2012.  
 Notes:  
<sup>a</sup> The SEL represents a receiver's cumulative noise exposure from an event and represents the total A-weighted sound during the event normalized to a 1-second interval. This noise descriptor is used to assess effects on wildlife and domestic animals.  
<sup>b</sup> These projections assume a safety barrier on the edge of the aerial structure as shown in typical cross sections (see Chapter 2, Alternatives). The safety barrier is assumed to be 3 feet above the top of rail height and 15 feet from the track centerline.  
 Acronyms:  
 dBA A-weighted decibel(s)  
 mph mile(s) per hour  
 SEL sound exposure level

**Impact N&V #5 – Impacts from Project Vibration**

The FRA guidelines provide ground-borne vibration impact criteria as shown in Table 3.4-6 (FRA 2005). These levels represent the maximum RMS level of an event.

Table 3.4-27 provides the distances to the calculated vibration contours for the three land use categories for frequent events, assuming an HST speed of 220 mph. Vibration impacts associated with exposure of persons to excessive ground-borne vibration levels can be perceptible and intrusive to building occupants and can cause secondary rattling of windows, items on shelves, and pictures hanging on walls but would not cause damage to structures.

**BNSF Alternative.** Vibration effects would have substantial intensity under NEPA and the impact would be significant under CEQA at 40 receivers along the BNSF Alternative. Category 1, 2, and 3 land use sensitive receivers within the approximated vibration contour distances of the BNSF Alternative centerline are presented in Table 3.4-28.

**Table 3.4-27**  
 Approximate Distances to Vibration Criterion Level Contours

| Land Use Category | Vibration Criterion Level (VdB) | Approximated Vibration Contour Distance (feet) |          |
|-------------------|---------------------------------|--|----------|
|                   |                                 | At-grade                                       | Elevated |
| Category 1        | 65                              | 190  | 62       |
| Category 2        | 72                              | 86   | 28       |
| Category 3        | 75                              | 62   | 20       |

Source: Authority and FRA 2012.  
 Acronym:  
 VdB vibration velocity level

**Table 3.4-28**  
 Sensitive Vibration Receivers along the BNSF Alternative

| BNSF Alternative Section | Number of Sensitive Receivers |
|--------------------------|-------------------------------|
| Fresno                   | 1 residences                  |
| Hanford                  | 8 residences                  |
| Through Corcoran         | 11 residences                 |
| Pixley                   | None                          |
| Through Allensworth      | 1 residences                  |
| Through Wasco-Shafter    | 5 residences                  |
| Bakersfield              | 14 residences                 |

Source: Authority and FRA 2012.

**Hanford West Bypass 1 Alternative.** Vibration effects to receivers adjacent to the HST alignment would have substantial intensity under NEPA, and the impact would be significant under CEQA for the Hanford West Bypass 1 Alternative. This alternative would impact 4 fewer sensitive receivers with the at-grade station option and 6 fewer receivers with the below-grade station option compared to the corresponding segment of the BNSF Alternative.

**Hanford West Bypass 2 Alternative.** Vibration effects to receivers adjacent to the HST alignment would have substantial intensity under NEPA, and the impact would be significant under CEQA for the Hanford West Bypass 2 Alternative. This alternative would impact 2 fewer sensitive receivers with the at-grade station option and 4 fewer receivers with the below-grade station option compared to the corresponding segment of the BNSF Alternative.

**Corcoran Elevated Alternative.** Vibration effects to receivers adjacent to the HST alignment would have no impact under NEPA or CEQA for the Corcoran Elevated Alternative. This alternative would eliminate the impact to all 11 sensitive receivers compared to the corresponding segment of the BNSF Alternative.

**Corcoran Bypass Alternative.** Vibration effects to receivers adjacent to the HST alignment would have substantial intensity under NEPA, and the impact would be significant under CEQA for the Corcoran Bypass Alternative. This alternative would impact 9 additional sensitive receivers compared to the corresponding segment of the BNSF Alternative.

**Allensworth Bypass Alternative.** Vibration effects to receivers adjacent to the HST alignment would have substantial intensity under NEPA, and the impact would be significant under CEQA for the Allensworth Bypass Alternative. This alternative would impact the same number of sensitive receivers as the corresponding segment of the BNSF Alternative.

**Wasco-Shafter Bypass Alternative.** Vibration effects to receivers adjacent to the HST alignment would have substantial intensity under NEPA, and the impact would be significant under CEQA for the Wasco-Shafter Bypass Alternative. This alternative would impact 3 fewer sensitive receivers compared to the corresponding segment of the BNSF Alternative.

**Bakersfield South Alternative.** Vibration effects to receivers adjacent to the HST alignment would have substantial intensity under NEPA, and the impact would be significant under CEQA for

the Bakersfield South Alternative. This alternative would impact the same number of sensitive receivers as the corresponding segment of the BNSF Alternative.

**Bakersfield Hybrid Alternative.** Vibration effects to receivers adjacent to the HST alignment would have substantial intensity under NEPA, and the impact would be significant under CEQA for the Bakersfield South Alternative. This alternative would impact the same number of sensitive receivers as the corresponding segment of the BNSF Alternative.

**HMF Sites.** Operation of the heavy maintenance facility would not require equipment that would create ground-borne vibrations. Because this type of this equipment would not be used at these sites, nearby sensitive receivers would not experience any vibrations as a result of the operation of the heavy maintenance facility. There would be no vibration effects under NEPA, and no impacts under CEQA.

**Schools.** No schools are within the vibration-impact screening distances; therefore, no schools are expected to be affected by vibration. There would be no vibration effects under NEPA, and no impacts under CEQA.

### ***Impact N&V #6 - Traffic Noise***

Implementation of the HST will cause increased traffic volumes in the areas around the station locations and changes in traffic patterns in areas where streets would be closed. The three major areas where traffic volumes would be increased would be around the City of Fresno, east and west of the City of Hanford, and in the City of Bakersfield. One additional area where roadways would be closed or realigned is in the City of Corcoran. Future traffic conditions with and without the HST project are compared in order to analyze the change in noise levels due to the increase in average daily traffic (ADT) volumes or changes in the peak hour traffic volumes in these four cities. Estimated traffic volumes for the year 2035 were obtained from the project traffic study and are used in this analysis. Where traffic noise is predicted to approach or exceed the criteria presented in Table 3.4-4 during the noisiest 1-hour period, noise abatement measures must be considered. Caltrans defines "approach" as a peak-noise-hour sound level of 66 dBA  $L_{eq}$  in residential areas.

Twenty-three major roadway intersections in the city of Fresno were analyzed. Less than half of these intersections would experience an increase in traffic as a result of the project. For most of the intersections that would have a project increase in traffic, the increase in peak hour noise would be 1 dB or less. Future peak-hour sound levels of less than 66 dBA  $L_{eq}$  would result at the nearest residential property line. This slight increase in noise would have negligible intensity under NEPA and the impact would be less than significant under CEQA. Several roadways would have a 1 dB increase in peak hour  $L_{eq}$  noise, with the greatest increase projected for the intersection of Van Ness Avenue and California Avenue which shows a peak hour noise increase of 5 dB  $L_{eq}$ . All of the roads with a noise increase above 1 dB are located in commercial or industrial areas. These increases are not considered to be significant according to FHWA standards; therefore, the noise effect would have negligible intensity under NEPA and the impact would be less than significant under CEQA.

Thirteen major roadway segments in the area around the proposed Kings/Tulare Regional Station – East were analyzed. An increase in traffic volume is expected on SR 43 between Grangeville Boulevard and SR 198. The increases in traffic volume would result in an increase in the future peak-hour noise level of 1 dBA  $L_{eq}$ . This would result in five homes that face SR 43 being exposed to a peak-hour noise level in excess of 66 dBA  $L_{eq}$ . This noise effect would have a moderate intensity under NEPA and it would be a significant impact under CEQA.

Twenty-one major roadway segments west of the City of Hanford were analyzed for the Kings/Tulare Regional Station – West. An increase in traffic volume is expected for one-third of

the roadway segments. All of the increases in traffic volume would increase the future dBA  $L_{eq}$  values by 3 dB or less. The resulting peak-hour volumes are so low they would not generate a sound level of 66 dBA  $L_{eq}$  at a distance of 50 feet. This slight increase in noise would have negligible intensity under NEPA, and be less than significant under CEQA. A few of the intersection legs show a 1- or 2-dBA increase in peak-hour noise, and the greatest increase would be at the intersection of 13<sup>th</sup> Avenue/SR 198 WB ramp, which shows a peak-hour increase of 3 dB  $L_{eq}$ . These increases are not considered to be significant according to FHWA standards; therefore, the noise would have negligible intensity under NEPA, and the impact would be less than significant impact under CEQA.

Four major roadway intersections in the City of Corcoran were analyzed. An increase in peak hour traffic is expected on most of these roadway segments. All of the increases in traffic volume would result in increasing the peak-hour traffic noise level by 1 to 7 dBA  $L_{eq}$ . These increases are not considered to be significant according to FHWA standards. The traffic increase would result in one home that faces Whitley Avenue being exposed to a peak-hour noise level in excess of 66 dBA  $L_{eq}$ . This noise effect would have moderate intensity under NEPA and it would be a significant impact under CEQA.

Seventy-two major roadway intersections in the City of Bakersfield were analyzed. An increase in traffic volume is expected for most of the roadway intersections. A few of the increases in traffic volume would increase the future peak hour dBA  $L_{eq}$  values by 1 or 2 dBA, and the resulting peak-hour volumes are so low they would not generate a sound level of 66 dBA  $L_{eq}$  at the nearest residential property line. This slight increase in noise would have negligible intensity under NEPA, and the impact would be less than significant under CEQA. The majority of roadways analyzed for increases in peak-hour traffic show no increase in noise. A few roadways show a 2 dB increase in peak-hour  $L_{eq}$  noise, and the greatest increase would be at the intersection of Union Avenue/Hayden Court/Sonora Street, which shows a peak-hour increase of 5 dB  $L_{eq}$ . All of these increases are in commercial or industrial areas. These increases are not considered to be significant according to FHWA standards; therefore, they would have negligible intensity under NEPA, and the impact would be less-than-significant impact CEQA.

### 3.4.6 Project Design Features

The Authority and the FRA have considered avoidance and minimization measures consistent with the Statewide and Bay Area to Central Valley Program EIR/EIS commitments. FTA and FRA have guidelines for minimizing noise and vibration impacts at sensitive receptors that will be followed during construction.

### 3.4.7 Mitigation Measures

In addition, the following mitigation measures are available to compensate for impacts that cannot be minimized or avoided. The Authority has developed proposed Noise and Vibration Mitigation Guidelines that identify criteria by which noise and vibration mitigation would be deemed effective. The proposed Noise and Vibration Mitigation Guidelines are included as Appendix 3.4-A.

#### 3.4.7.1 Construction Period

**N&V-MM#1: Construction noise mitigation measures.** Monitor construction noise to verify compliance with the noise limits. Provide the contractor the flexibility to meet the FRA construction noise limits in the most efficient and cost-effective manner. The contractor would have the flexibility of either prohibiting certain noise-generating activities during nighttime hours or providing additional noise control measures to meet the noise limits. To meet required noise

limits, the following noise control mitigation measures will be implemented as necessary, for nighttime and daytime:

- Install a temporary construction site sound barrier near a noise source.
- Avoid nighttime construction in residential neighborhoods.
- Locate stationary construction equipment as far as possible from noise-sensitive sites.
- Re-route construction truck traffic along roadways that will cause the least disturbance to residents.
- During nighttime work, use smart back-up alarms, which automatically adjust the alarm level based on the background noise level, or switch off back-up alarms and replace with spotters.
- Use low-noise emission equipment.
- Implement noise-deadening measures for truck loading and operations.
- Monitor and maintain equipment to meet noise limits.
- Line or cover storage bins, conveyors, and chutes with sound-deadening material.
- Use acoustic enclosures, shields, or shrouds for equipment and facilities.
- Use high-grade engine exhaust silencers and engine-casing sound insulation.
- Prohibit aboveground jackhammering and impact pile driving during nighttime hours.
- Minimize the use of generators to power equipment.
- Limit use of public address systems.
- Grade surface irregularities on construction sites.
- Use moveable sound barriers at the source of the construction activity.
- Limit or avoid certain noisy activities during nighttime hours.

To mitigate noise related to pile driving, the use of an auger to install the piles instead of a pile driver would reduce noise levels substantially. If pile driving is necessary, limit the time of day that the activity can occur.

**N&V-MM#2: Construction vibration mitigation measures.** Building damage from construction vibration is only anticipated from impact pile driving at very close distances to buildings. If pile driving occurs more than 25 to 50 feet from buildings, or if alternative methods such as push piling or auger piling can be used, damage from construction vibration is not expected to occur. Other sources of construction vibration do not generate high enough vibration levels for damage to occur. Typically, once a construction scenario has been established, preconstruction surveys are conducted at locations within 50 feet of pile driving to document the existing condition of buildings in case damage is reported during or after construction. Damaged buildings would be repaired or compensation paid.

### 3.4.7.2 PROJECT

#### Noise

**N&V-MM#3: Implement Proposed California High-Speed Train Project Noise Mitigation Guidelines.** Figures 3.4-9 through 3.4-13 show the locations where the noise mitigation guidelines would be applied. Various options exist to address the potentially severe noise effects from HSTs. After receiving input from local jurisdictions and balancing technological factors, such as structural and seismic safety, cost, number of affected receivers, and effectiveness, mitigation measures would be selected and implemented. For example, where moderate increases in noise affect receivers, noise-reducing measures could be implemented, even though not required. Conversely, in rural areas devoid of receivers where severe noise effects are anticipated, it might be appropriate and acceptable not to apply any noise-reducing treatments. The noise guidelines include the following mitigation measures:

- Install sound barriers. Depending on the height and location relative to the tracks, sound barriers can achieve between 5 and 15 dB of noise reduction. The primary requirements for

an effective sound barrier are that the barrier must (1) be high enough and long enough to break the line-of-sight between the sound source and the receiver, (2) be of an impervious material with a minimum surface density of 4 pounds per square foot, and (3) not have any gaps or holes between the panels or at the bottom. Because many materials meet these requirements, aesthetics, durability, cost, and maintenance considerations usually determine the selection of materials for sound barriers (examples are shown in Figure 3.4-14).

Depending on the situation, sound barriers can become visually intrusive. Typically, the sound barriers style is selected with input from the local jurisdiction to reduce the visual effect of barriers on adjacent lands uses. For example, sound barriers could be solid or transparent, and made of various colors, materials, and surface treatments.

The minimum number of affected sites should be at least 10, and the length of a sound barrier should be at least 800 feet. The maximum sound barrier height would be 14 feet for at-grade sections; however, all sound barriers would be designed to be as low as possible to achieve a substantial noise reduction. Berm and berm/wall combinations are the preferred types of sound barriers where space and other environmental constraints permit. On aerial structures, the maximum sound barrier height would also be 14 feet, but barrier material would be limited by engineering weight restrictions for barriers on the structure. Sound barriers on the aerial structure will still be designed to be as low as possible to achieve a substantial noise reduction. Sound barriers on both aerial structures and at-grade structures could consist of solid, semitransparent, or transparent materials.

- Work with the communities to identify how the use and height of sound barriers would be determined using jointly developed performance criteria. Other solutions may result in higher numbers of residual impacts than reported herein. Options may be to reduce the height of sound barriers and combine barriers with sound insulation or to accept higher noise thresholds than the FRA's current noise thresholds.
- Install building sound insulation. Sound insulation of residences and institutional buildings to improve the outdoor-to-indoor noise reduction is a mitigation measure that can be provided when the use of sound barriers is not feasible in providing a reasonable level (5 to 7 dB) of noise reduction. Although this approach has no effect on noise in exterior areas, it may be the best choice for sites where sound barriers are not feasible or desirable and for buildings where indoor sensitivity is of most concern. Substantial improvements in building sound insulation (on the order of 5 to 10 dB) can often be achieved by adding an extra layer of glazing to windows, by sealing holes in exterior surfaces that act as sound leaks, and by providing forced ventilation and air conditioning so that windows do not need to be opened. Performance criteria would be established to balance existing noise events and ambient roadway noise conditions as factors for determining mitigation measures.
- Acquire easements on properties severely affected by noise. Another option for mitigating noise impacts is for the authority to acquire easements on residences likely to be impacted by HST operations in which the homeowners would accept the future noise conditions. This approach is usually taken only in isolated cases where other mitigation options are infeasible, impractical, or too costly.

Tables 3.4-29 through 3.4-32 show the number and length of sound barriers that would be cost effective for the Fresno to Bakersfield Section alternatives based on implementation of the noise mitigation guidelines. Figures 3.4-15 through 3.4-19 show the locations of potential sound barriers along the project alternatives.



(a) Denver, Colorado



(b) Slovenia, Italy



(c) Sha Tin, Hong Kong



(d) Loire Valley, France

**Figure 3.4-14**  
Examples of sound barriers for rail corridors

*(Photographs courtesy of Harris Miller Miller & Hanson Inc.)*

**Table 3.4-29**  
 Potential Sound Barrier Mitigation for Operational Noise for BNSF Alternative

| Receiver Location   |                  | Total Length (feet) | Barrier Height <sup>a</sup> (feet) | Benefited Receivers <sup>b</sup> | Number of Severe Residual Impacts |
|---|------------------|---------------------|------------------------------------|----------------------------------|-----------------------------------|
| <b>Fresno Area</b>  |                  |                     |                                    |                                  |                                   |
| No sound barrier mitigation proposed for the Fresno Area              |                  |                     |                                    |                                  | 33                                |
| <b>Monmouth Area</b>  |                  |                     |                                    |                                  |                                   |
| No sound barrier mitigation proposed for the Monmouth Area            |                  |                     |                                    |                                  | 51                                |
| <b>East Hanford Area</b>  |                  |                     |                                    |                                  |                                   |
| No sound barrier mitigation proposed for the Hanford Area             |                  |                     |                                    |                                  | 178                               |
| <b>Corcoran Area</b>  |                  |                     |                                    |                                  |                                   |
| North of Newark Ave. to South of Oregon Ave.                          | Southbound track | 10,245              | 14                                 | 294                              | 64                                |
| South of Niles Ave. to north of Sherman Ave.                          | Northbound track | 3,246               | 14                                 | 49                               | 15                                |
| <b>Pixley Area</b>  |                  |                     |                                    |                                  |                                   |
| No sound barrier mitigation proposed for the Pixley Area              |                  |                     |                                    |                                  | 2                                 |
| <b>Allensworth Area</b>   |                  |                     |                                    |                                  |                                   |
| No sound barrier mitigation proposed for the Allensworth Area         |                  |                     |                                    |                                  | 14                                |
| <b>Wasco-Shafter Area</b>   |                  |                     |                                    |                                  |                                   |
| City of Wasco – North of McCombs Ave. to South of Jackson Ave.        | Southbound track | 10,522              | 14                                 | 215                              | 156                               |
| City of Shafter - Popular Ave. at the North of Shafter to E. Ash Ave. | Southbound track | 12,264              | 14                                 | 165                              | 97                                |
| South of Paso Robles Hwy (46) to South of Poso Ave. (Wasco)           | Northbound track | 5,095               | 14                                 | 78                               | 148                               |
| South of Fresno Ave to north of E. Lerdo Hwy (Shafter)                | Northbound track | 7,205               | 14                                 | 202                              | 130                               |
| <b>Bakersfield Area</b>   |                  |                     |                                    |                                  |                                   |
| South of Allen Rd. to north of Palm Ave.                              | Southbound track | 10,111              | 14                                 | 231                              | 6                                 |
| North of Palm Ave to south of Coffee Rd                               | Southbound track | 7,862               | 14                                 | 1,030 <sup>c</sup>               | 1                                 |
| Mohawk St. to Oswell St.  | Southbound track | 28,096              | 14                                 | 3,246 <sup>d</sup>               | 0                                 |
| North of Jomani Dr. to South of Palm Rd.                              | Northbound track | 11,220              | 14                                 | 333 <sup>e</sup>                 | 7                                 |



**Table 3.4-29**  
 Potential Sound Barrier Mitigation for Operational Noise for BNSF Alternative

| Receiver Location   |                  | Total Length (feet) | Barrier Height <sup>a</sup> (feet) | Benefited Receivers <sup>b</sup> | Number of Severe Residual Impacts |
|---|------------------|---------------------|------------------------------------|----------------------------------|-----------------------------------|
| South of Palm Ave. to West of Coffee Rd.  | Northbound track | 4,900               | 14                                 | 78 <sup>f</sup>                  | 0                                 |
| East of Interstate 99 to Oswell St.   | Northbound track | 28,467              | 14                                 | 2,121 <sup>g</sup>               | 0                                 |
| <b>Total</b>  |                  | <b>139,233</b>      | <b>14</b>                          | <b>8,042</b>                     | <b>902</b>                        |
| Source: Authority and FRA 2012.   |                  |                     |                                    |                                  |                                   |
| Notes:  |                  |                     |                                    |                                  |                                   |
| <sup>a</sup> Height above top-of-rail.  |                  |                     |                                    |                                  |                                   |
| <sup>b</sup> Receivers that obtain a 5 dBA reduction  |                  |                     |                                    |                                  |                                   |
| <sup>c</sup> Of the 1,030 benefited receivers 489 are severe impacts and 541 are moderate impacts     |                  |                     |                                    |                                  |                                   |
| <sup>d</sup> Of the 3,246 benefited receivers 1,026 are severe impacts and 2,220 are moderate impacts |                  |                     |                                    |                                  |                                   |
| <sup>e</sup> Of the 333 benefited receivers 173 are severe impacts and 160 are moderate impacts       |                  |                     |                                    |                                  |                                   |
| <sup>f</sup> Of the 78 benefited receivers 60 are severe impacts and 18 are Moderate impacts          |                  |                     |                                    |                                  |                                   |
| <sup>g</sup> Of the 2,121 benefited receivers 623 are severe impacts and 1,498 are moderate impacts   |                  |                     |                                    |                                  |                                   |

**Table 3.4-30**  
 Potential Mitigation for Operational Noise for Corcoran Elevated

| Receiver Location                                    |                  | Total Length (feet) | Barrier Height <sup>a</sup> (feet) | Benefited Receivers <sup>b</sup> | Number of Severe Residual Impacts |
|--|------------------|---------------------|------------------------------------|----------------------------------|-----------------------------------|
| North of Newark Ave to south of Oregon Ave.          | Southbound track | 12,700              | 14                                 | 366                              | 2                                 |
| South of North Ave. to north of Stanley Ave.         | Northbound track | 5,144               | 14                                 | 60                               | 25                                |
| Source: Authority and FRA 2012.                      |                  |                     |                                    |                                  |                                   |
| Note:  |                  |                     |                                    |                                  |                                   |
| <sup>a</sup> Height above top-of-rail.               |                  |                     |                                    |                                  |                                   |
| <sup>b</sup> Receivers that obtain a 5 dBA reduction |                  |                     |                                    |                                  |                                   |

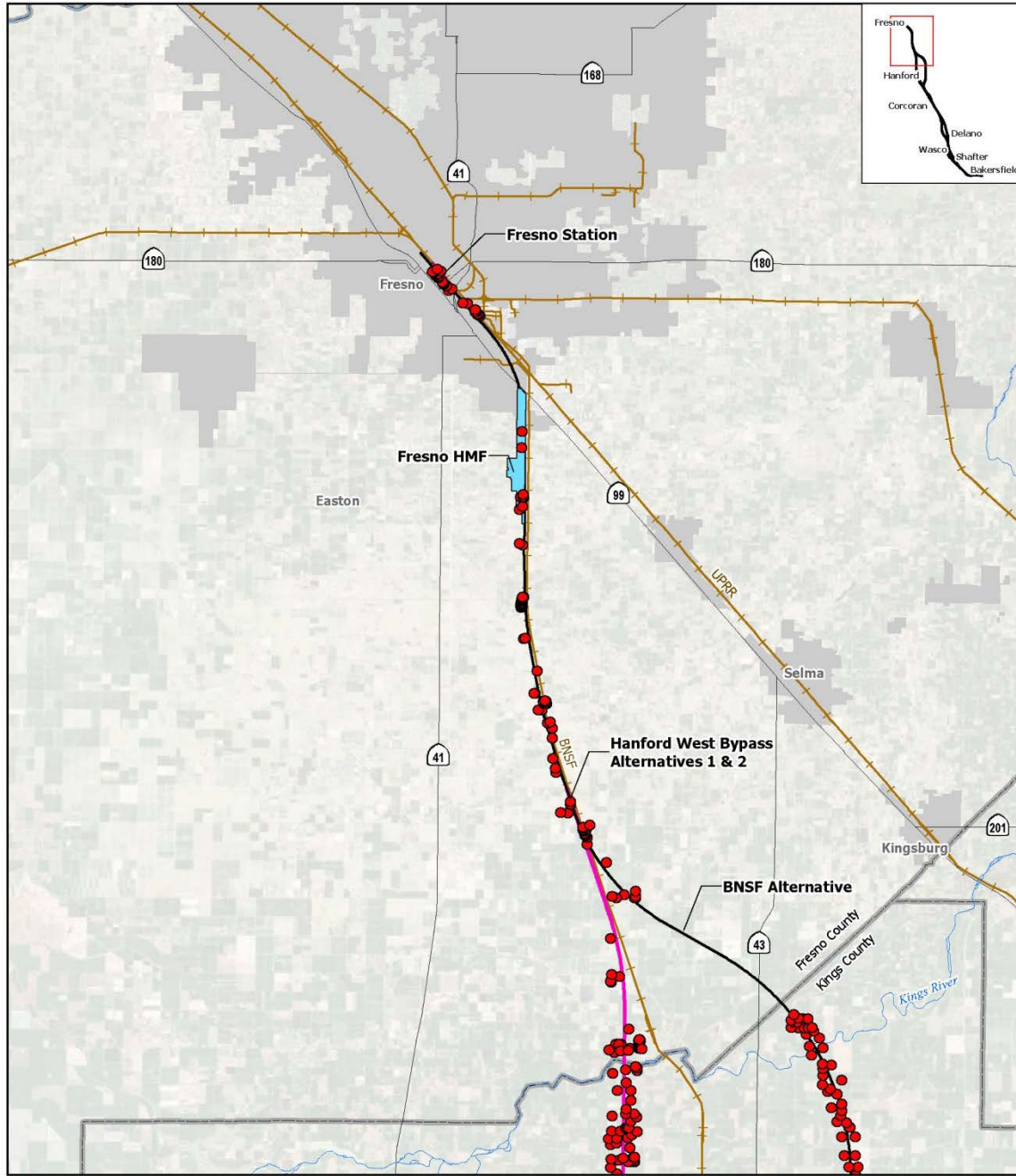
**Table 3.4-31**  
 Potential Mitigation for Operational Noise for Bakersfield South

| Receiver Location   |                  | Total Length (feet) | Barrier Height <sup>a</sup> (feet) | Benefited Receivers <sup>b</sup> | Number of Severe Residual Impacts |
|---|------------------|---------------------|------------------------------------|----------------------------------|-----------------------------------|
| North of Jomani Dr. to North of Palm Ave.   | Southbound track | 10,144              | 14                                 | 224                              | 29                                |
| North of Palm Ave. to South of Coffee Rd.   | Southbound track | 8,453               | 14                                 | 971 <sup>c</sup>                 | 0                                 |
| A St. to Oswell St.   | Southbound track | 23,817              | 14                                 | 3,934 <sup>d</sup>               | 0                                 |
| North of Jomani Dr. to South of Palm Ave.   | Northbound track | 10,720              | 14                                 | 1,791 <sup>e</sup>               | 35                                |
| South of Palm Ave. to West of Coffee Rd.  | Northbound track | 5,035               | 14                                 | 211 <sup>f</sup>                 | 0                                 |
| East Interstate 99 to Oswell St.  | Northbound track | 27,641              | 14                                 | 2,004 <sup>g</sup>               | 0                                 |
| Source: Authority and FRA 2012.   |                  |                     |                                    |                                  |                                   |
| Note:   |                  |                     |                                    |                                  |                                   |
| <sup>a</sup> Height above top-of-rail.  |                  |                     |                                    |                                  |                                   |
| <sup>b</sup> Receivers that obtain a 5 dBA reduction  |                  |                     |                                    |                                  |                                   |
| <sup>c</sup> Of the 971 benefited receivers 400 are severe impacts and 571 are moderate impacts       |                  |                     |                                    |                                  |                                   |
| <sup>d</sup> Of the 3,934 benefited receivers 1,484 are severe impacts and 2,450 are moderate impacts |                  |                     |                                    |                                  |                                   |
| <sup>e</sup> Of the 1,791 benefited receivers 164 are severe impacts and 1627 are Moderate Impacts    |                  |                     |                                    |                                  |                                   |
| <sup>f</sup> Of the 211 benefited receivers 30 are severe impacts and 1,81 are moderate impacts       |                  |                     |                                    |                                  |                                   |
| <sup>g</sup> Of the 2,004 benefited receivers 672 are severe impacts and 1,332 are moderate impacts   |                  |                     |                                    |                                  |                                   |

**Table 3.4-32**  
 Potential Mitigation for Operational Noise for Bakersfield Hybrid

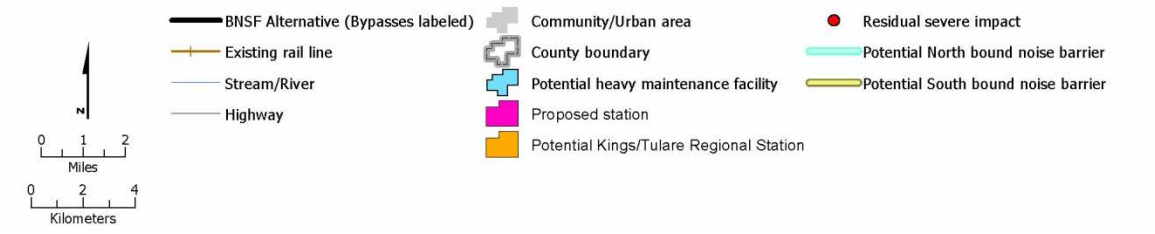
| Receiver Location                         |                  | Total Length (feet) | Barrier Height <sup>a</sup> (feet) | Benefited <sup>b</sup> Receivers | Number of Severe Residual Impacts |
|---|------------------|---------------------|------------------------------------|----------------------------------|-----------------------------------|
| North of Jomani Dr. to North of Palm Ave. | Southbound Track | 10,144              | 14                                 | 224                              | 29                                |
| North of Palm Ave. to South of Coffee Rd. | Southbound Track | 8,453               | 14                                 | 971 <sup>c</sup>                 | 7                                 |
| East of Williams St. to Oswell St.        | Southbound Track | 8,333               | 14                                 | 874 <sup>d</sup>                 | 0                                 |
| North of Jomani Dr. to South of Palm Ave. | Northbound track | 10,720              | 14                                 | 1,791 <sup>e</sup>               | 35                                |
| South of Palm Ave. to West of Coffee Rd.  | Northbound track | 5,035               | 14                                 | 211 <sup>f</sup>                 | 0                                 |
| West of Oak St. to East of B St.          | Northbound Track | 3,851               | 14                                 | 63                               | 24                                |
| East of Washington St. to Oswell St.      | Northbound Track | 8,813               | 14                                 | 937 <sup>g</sup>                 | 0                                 |

Source: Authority and FRA 2012.  
 Note:  
<sup>a</sup> Height above top-of-rail.  
<sup>b</sup> Receivers that obtain a 5 dBA reduction  
<sup>c</sup> Of the 971 benefited receivers, 400 are severe impacts and 571 are moderate impacts  
<sup>d</sup> Of the 874 benefited receivers, 194 are severe impacts and 680 are moderate impacts  
<sup>e</sup> Of the 1,791 benefited receivers, 164 are severe and 1,627 are moderate impacts  
<sup>f</sup> Of the 211 benefited receivers, 30 are severe impacts and 181 are moderate impacts  
<sup>g</sup> Of the 937 benefited receivers, 309 are severe impacts and 628 are moderate impacts

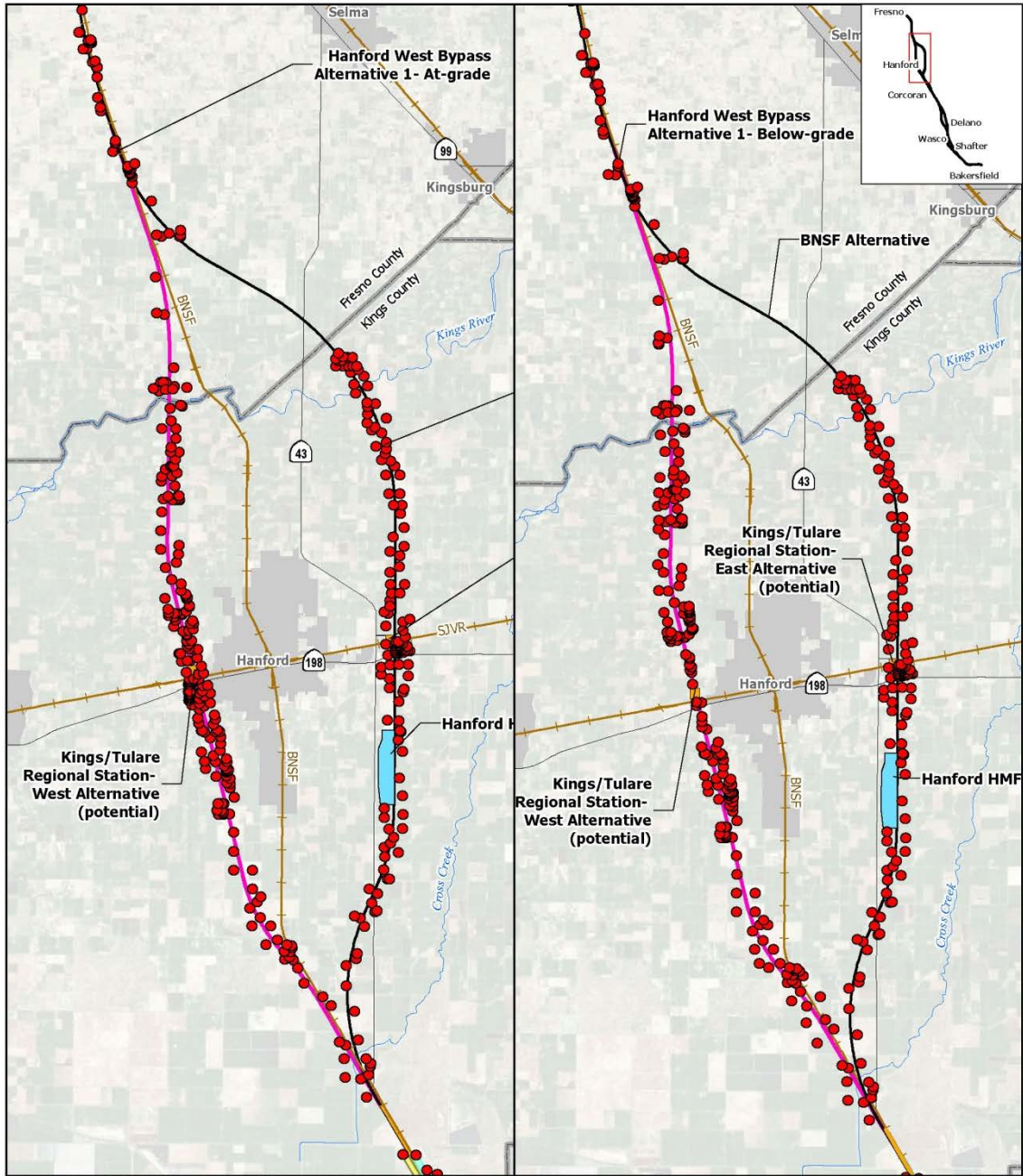


PRELIMINARY DRAFT/SUBJECT TO CHANGE - HST ALIGNMENT IS NOT DETERMINED  
 Data source: URS 2012

June 07, 2012

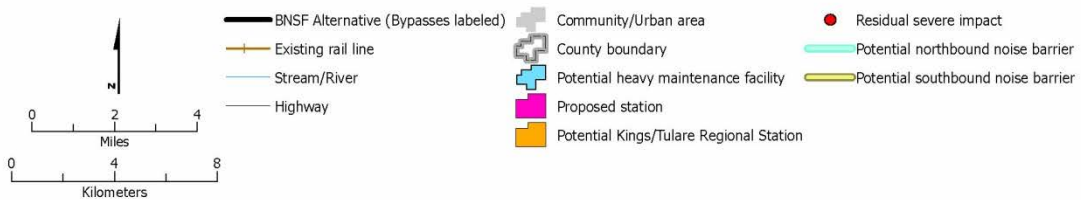


**Figure 3.4-15**  
 Fresno area: Potential sound barrier sites

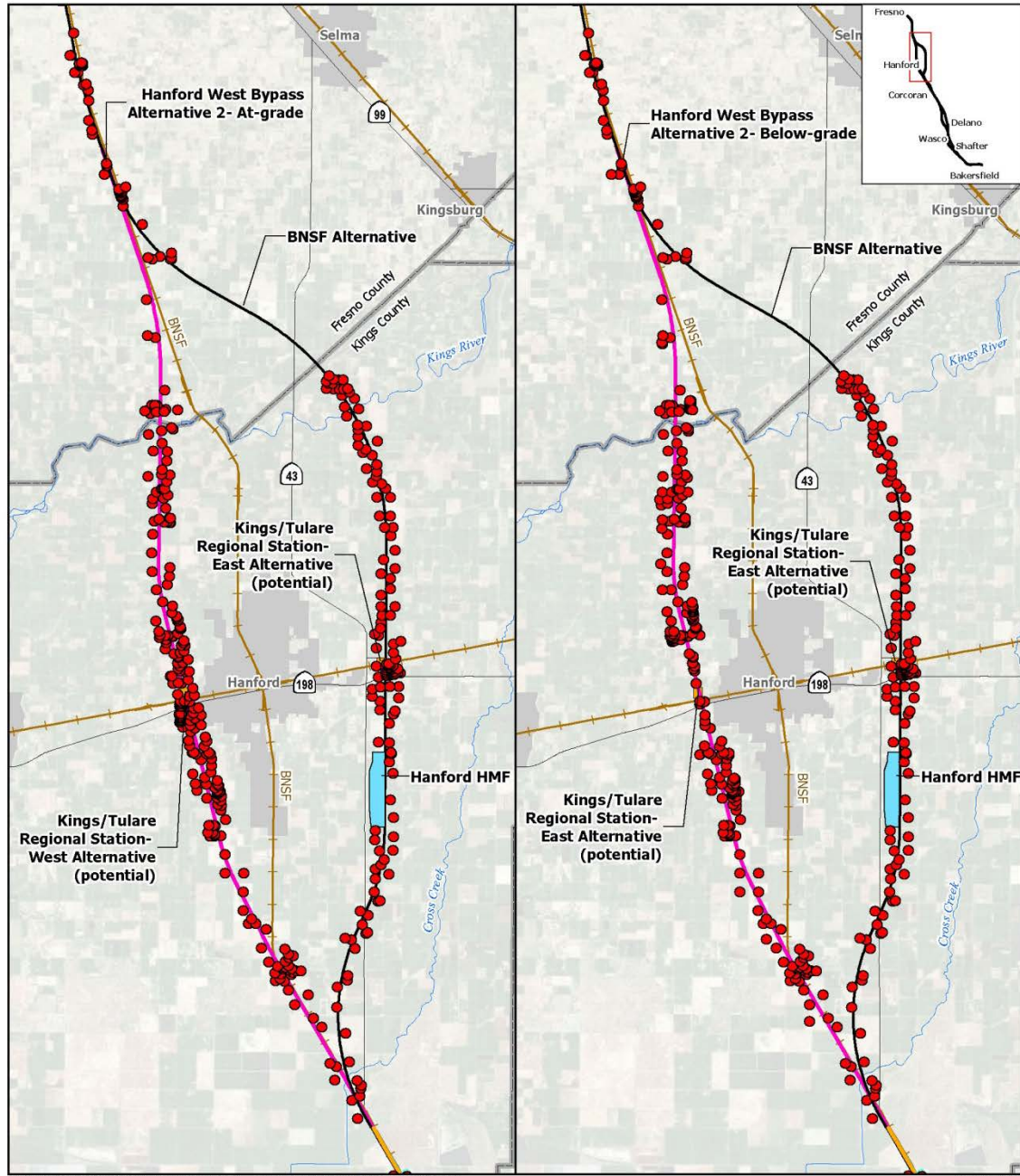


PRELIMINARY DRAFT/SUBJECT TO CHANGE - HST ALIGNMENT IS NOT DETERMINED  
 Data source: URS 2012

June 06, 2012

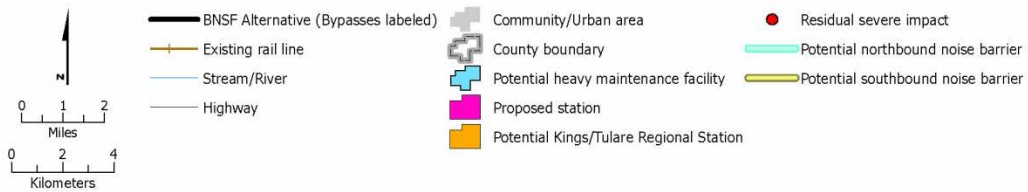


**Figure 3.4-16**  
 Hanford / Alt 1 area: Potential sound barrier sites

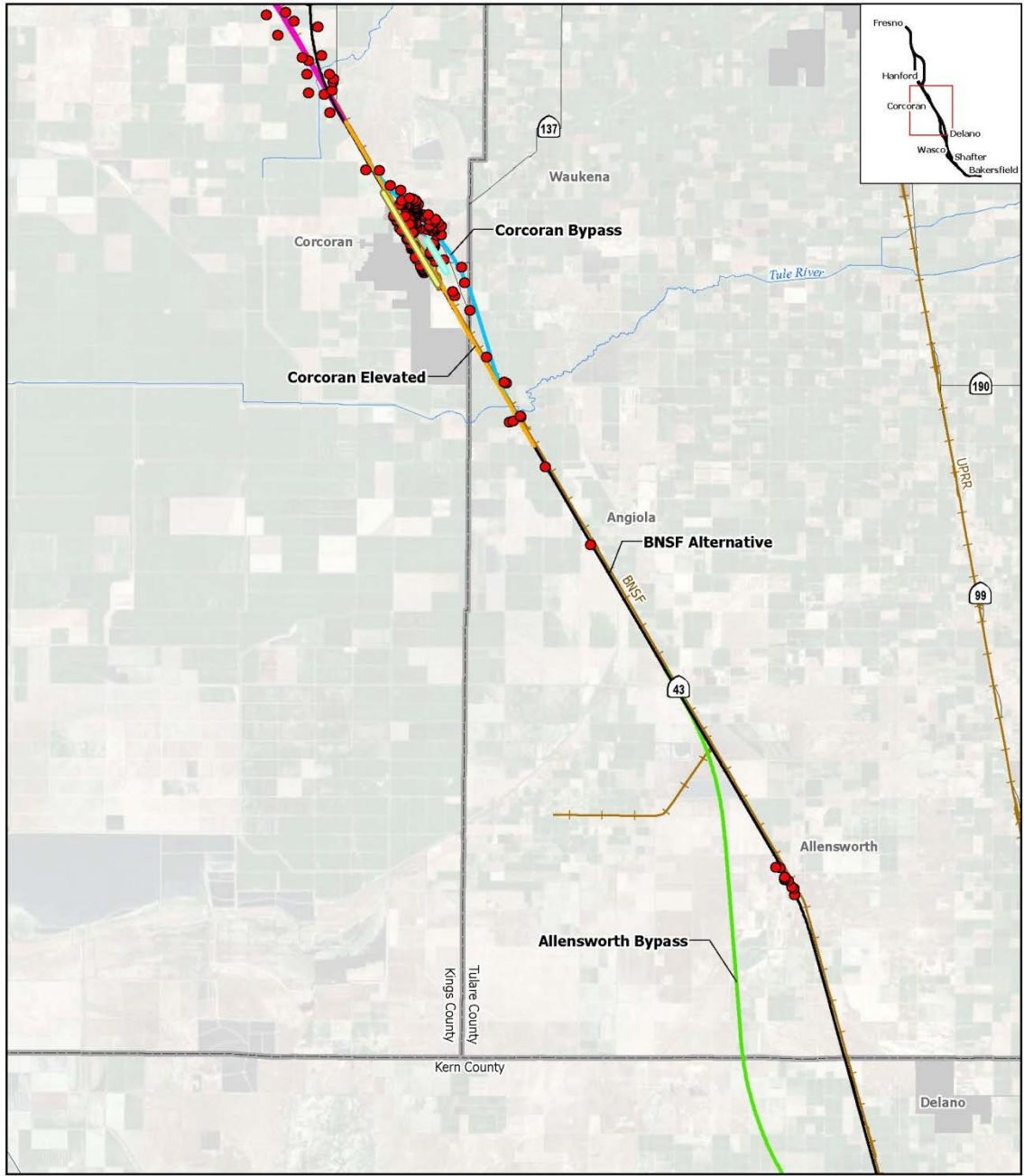


PRELIMINARY DRAFT/SUBJECT TO CHANGE - HST ALIGNMENT IS NOT DETERMINED  
 Data source: URS 2012

June 06, 2012

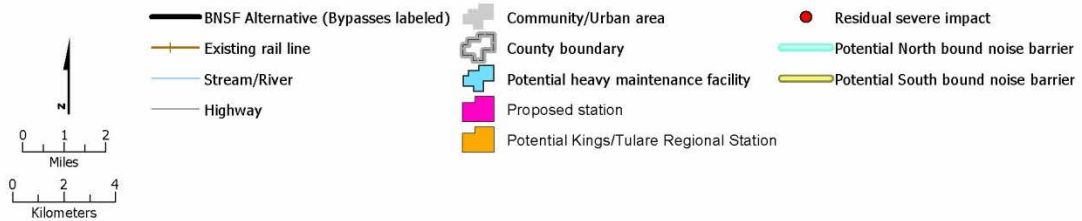


**Figure 3.4-17**  
 Hanford / Alt 2 area: Potential sound barrier sites

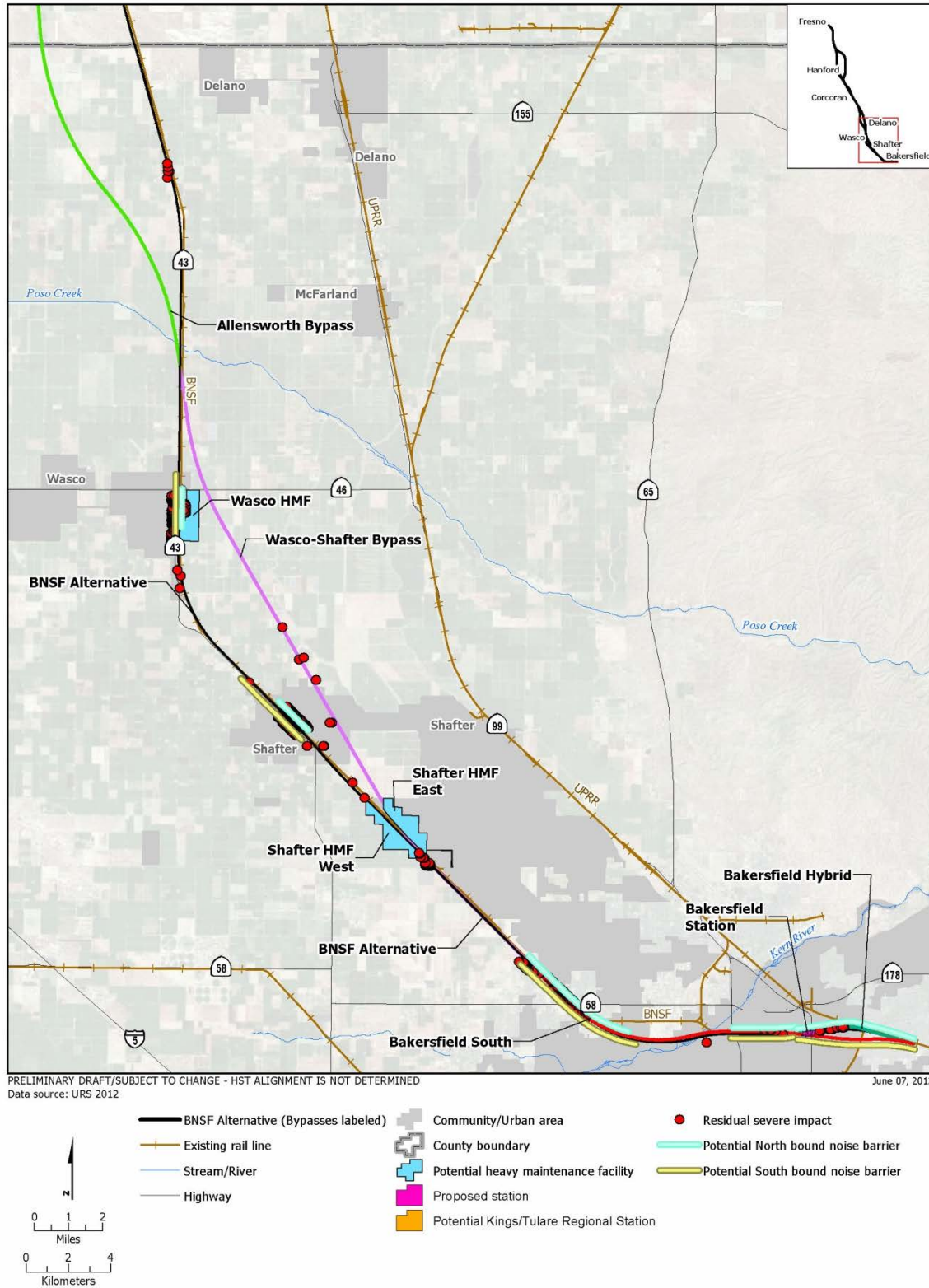


PRELIMINARY DRAFT/SUBJECT TO CHANGE - HST ALIGNMENT IS NOT DETERMINED  
 Data source: URS 2012

June 07, 2012



**Figure 3.4-18**  
 Corcoran area: Potential sound barrier sites



**Figure 3.4-19**  
 Bakersfield area: Potential sound barrier sites



***BNSF Alternative Potential Mitigation Locations***

Figures 3.4-15 through 3.4-19 show the locations where the criteria were met for the construction of sound barriers for all HST alternatives in the Fresno to Bakersfield Section. Table 3.4-29 summarizes potential sound barrier mitigation for operational noise for the BNSF Alternative during the design year (2035). The location of sound barriers as mitigation is shown on the table where a minimum of 5 dBA noise reduction at the impact receiver can be achieved. The table also summarizes the total length, maximum barrier height, the number of benefitted receivers, and the number of residual (post-mitigation) impacts within each portion of the alignment. The table references barrier heights from the top-of-rail elevation. A total of 11 sound barriers would be installed, with a combined length of approximately 139,233 feet and maximum height of 14 feet, for the BNSF Alternative. Only barrier mitigation measures providing 5 dBA, or more, of noise reduction have been applied in the HST alternative tables that follow (Tables 3.4-29 through 3.4-32).

These sound barriers would mitigate 76% of the severe noise impacts in the Corcoran area, 55% of the severe noise impacts in the Wasco-Shafter area, and 99% of the severe noise impacts in the Bakersfield area. Noise receivers severely impacted in the Fresno, East Hanford, Pixley, and Allensworth areas, as well as those noise receivers severely impacted in Corcoran, Wasco, Shafter, and Bakersfield, would not be mitigated by a sound barrier; because they are shown to be economically unfeasible, they would receive other forms of mitigation, such as building insulation or payment of property noise easements.

***Hanford West Bypass 1 (At-Grade) Potential Mitigation Locations***

This portion of the project alignment travels around the western side of Hanford, extending from just south of Kamm Avenue to south of Highway 43. This alternative alignment will be at-grade from Kamm Avenue to just south of Barrett Avenue. After passing Barrett Avenue, the alternative alignment will incline to 40 feet above ground level until passing Douglas Avenue. After passing Douglas Avenue, the alternative alignment will decline back to ground level and continue at ground level until connecting with the Corcoran alignment. At the southern end of this alternative alignment, the rail line will bow out to the west from Jackson Avenue to Kansas Avenue before connecting with the Corcoran alignment. A total of 232 severe noise impact sites along the western and eastern sides of this alternative are not suitable for sound barriers, because they are shown to be economically unfeasible. Other mitigation in the form of building insulation or payment of property noise easements would be implemented to reduce impacts at these locations.

***Hanford West Bypass 1 Alternative (Below Grade) Potential Mitigation Locations***

This portion of the project alignment travels around the western side of Hanford, extending from just south of Kamm Avenue to south of Highway 43. This alternative alignment will be at-grade from just south of Kamm Avenue to north of Riverdale Avenue. Just before passing Riverdale Avenue, the alternative alignment will incline to 40 feet above ground level until passing over Kings River. After passing Kings River, the alternative alignment will decline back to ground level and continue at ground level until connecting with the Corcoran alignment. At the southern end of this alternative alignment the rail line will bow out to the west from Jackson Avenue to Kansas Avenue before connecting with the Corcoran alignment. A total of 231 severe noise impact sites along the western and eastern sides of this alternative are not suitable for sound barriers because they are shown to be economically unfeasible. Other mitigation in the form of building insulation or payment of property noise easements would be implemented to reduce impacts at these locations.

### ***Hanford West Bypass 2 Alternative (At-grade) Potential Mitigation Locations***

This portion of the project alignment travels around the western side of Hanford, extending from just south of Kamm Avenue to south of Highway 43. This alternative alignment will be at-grade from Kamm Avenue to just south of Barrett Avenue. After passing Barrett Avenue, the alternative alignment will incline to 40 feet above ground level until passing Douglas Avenue. After passing Douglas Avenue, the alternative alignment will decline back to ground level and continue at ground level until connecting with the Corcoran alignment. A total of 252 severe noise impact sites along the western and eastern sides of this alternative are not suitable for sound barriers because they are shown to be economically unfeasible. Other mitigation in the form of building insulation or payment of property noise easements would be implemented to reduce impacts at these locations.

### ***Hanford West Bypass 2 Alternative (Below Grade) Potential Mitigation Locations***

This portion of the project alignment travels around the western side of Hanford, extending from just south of Kamm Avenue to south of Highway 43. This alternative alignment will be at-grade from just south of Kamm Avenue to north of Riverdale Avenue. Just before passing Riverdale Avenue, the alternative alignment will incline to 40 feet above ground level until passing over Kings River. After passing Kings River, the alternative alignment will decline back to ground level and continue at ground level until connecting with the Corcoran alignment. A total of 287 severe noise impact sites along the western and eastern sides of this alternative are not suitable for sound barriers because they are shown to be economically unfeasible. Other mitigation in the form of building insulation or payment of property noise easements would be implemented to reduce impacts at these locations.

### ***Corcoran Bypass Alternative Potential Mitigation Locations***

This portion of the project alignment extends from just north of Idaho Avenue to just northwest of the intersection of Avenue 128 and Road 32. Around the eastern side of the City of Corcoran, this alignment would be at-grade at an elevation of about 10 feet above the existing grade. A total of 111 severe noise impact sites along the western and eastern sides of this alternative are not suitable for sound barriers because they are shown to be economically unfeasible. Other mitigation in the form of building insulation or payment of property noise easements would be implemented to reduce impacts at these locations.

### ***Corcoran Elevated Alternative Potential Mitigation Locations***

This portion of the project alignment extends from just north of Idaho Avenue to just northwest of the intersection of Avenue 128 and Road 32. This alignment goes through Corcoran as an elevated alignment. This alternative will be elevated 33 feet above ground level from Niles Avenue south to 4th Avenue. The elevated alternative would be constructed on the eastern side of the BNSF track. Barrier 1 of this alternative would be on the southbound side of the alignment north of Newark Avenue to the south of Oregon Avenue. The total length of the barrier would be approximately 12,700 feet, and the height would be 14 feet. This barrier would benefit approximately 366 residential receivers. Barrier 2 of this alternative would be on the northbound side of the alignment south of North Avenue to north of Stanley Avenue. The total length of the barrier would be approximately 5,144 feet, and the height would be 14 feet. This barrier would benefit approximately 60 residential receivers. A total of 27 severe noise impact sites along the western and eastern sides of this section would not benefit from this barrier because they are shown to be economically unfeasible. The sound barrier results are presented in Table 3.4-30. Additional mitigation in the form of building insulation or payment of property noise easements would be implemented to reduce impacts at sensitive receivers not protected by sound barriers.

***Allensworth Bypass Alternative Potential Mitigation Locations***

This portion of the project alignment extends from just south of Avenue 84 to just south of Elmo Highway. The Allensworth Bypass Alternative would be at-grade and elevated to a height of approximately 8 feet above the existing grade. No noise receivers would be severely affected by this alternative.

***Wasco-Shafter Bypass Alternative Potential Mitigation Locations***

This portion of the project alignment extends from just northwest of Whisler Road to the intersection of Hageman Road and Rosedale Lane. This alignment is the only one under consideration for this portion of the project. The Wasco-Shafter Bypass, which runs around the eastern side of the City of Wasco and the City of Shafter, would be at-grade at an elevation of about 10 feet above the existing grade. The only exception would be the grade separation at 7<sup>th</sup> Standard Road. At this location, this alternative would be elevated to a height of 60 feet above-grade. A total of 90 severe noise impact sites along the western and eastern sides of this alternative are not suitable for sound barriers because they are shown to be economically unfeasible. Other mitigation in the form of building insulation or payment of property noise easements would be implemented to reduce impacts at these locations.

***Bakersfield South Alternative Potential Mitigation Locations***

This portion of the project alignment extends from the intersection of Hageman Road and Rosedale Lane past the east end of the proposed station in downtown Bakersfield to Oswell Street. The Bakersfield South Alternative would be at-grade for the western portion of the alignment (for approximately 11,330 feet), then be elevated to a height ranging from 50 to 80 feet throughout the rest of this segment of the project alignment.

Barrier 1 for the Bakersfield South Alternative would be built on the southbound side of the alignment from north of Jomani Drive to north of Palm Avenue. The total length of the barrier would be approximately 10,144 feet, and the height would be 14 feet. This barrier would benefit approximately 224 receivers, all of which are severe-impact receivers.

Barrier 2 of the Bakersfield South Alternative would be built on the southbound side of the alignment from north of Palm Avenue to south of Coffee Road. The total length of the barrier would be approximately 8,453 feet, and the height would be 14 feet. This barrier would benefit approximately 971 residential receivers, 400 of which are severe impact-receivers and 571 are moderate-impact receivers.

Barrier 3 of the Bakersfield South Alternative would be built on the southbound side of the alignment from A Street to Oswell Street. The total length of the barrier would be approximately 23,817 feet, and the height would be 14 feet. This barrier would benefit approximately 3,934 receivers, 1,484 of which are severe-impact receivers and 2,450 are moderate-impact receivers.

Barrier 4 of the Bakersfield South Alternative would be built on the northbound side of the alignment from north of Jomani Drive to south of Palm Avenue. The total length of the barrier would be approximately 10,720 feet, and the height would be 14 feet. This barrier would benefit approximately 1,791 receivers, of which 164 are severe-impact receivers, and 1,627 are moderate-impact receivers.

Barrier 5 of the Bakersfield South Alternative would be built on the northbound side of the alignment from south of Palm Avenue to west of Coffee Road. The total length of the barrier would be approximately 5,035 feet, and the height would be 14 feet. This barrier would benefit approximately 211 receivers, of which 30 are severe-impact receivers, and 181 are moderate-impact receivers.

Barrier 6 of the Bakersfield South Alternative would be built on the northbound side of the alignment east of SR 99 to Oswell Street. The total length of the barrier would be approximately 27,641 feet, and the height would be 14 feet. This barrier would benefit approximately 2,004 residential receivers, of which 672 are severe-impact receivers and 1,332 are moderate-impact receivers.

A total of 64 severe noise impact sites along the western and eastern sides of this section would not completely benefit from this barrier due to the specific site geometry; these receivers would receive less than a 5 dB reduction from the recommended noise barriers. The sound barrier results are presented in Table 3.4-30. Additional mitigation in the form of building insulation or payment of property noise easements would be implemented to reduce impacts at sensitive receivers not protected by sound barriers.

### ***Bakersfield Hybrid Alternative Potential Mitigation Locations***

This portion of the project alignment would be a “hybrid” of the Bakersfield South Alternative and the BNSF Bakersfield Alternative. The Bakersfield Hybrid Alternative would have the same alignment as the Bakersfield South Alternative from Hageman Road to between SR 99 and the Convention Center, and then follow the BNSF Bakersfield Alignment east of the convention center to Oswell Street. The Bakersfield Hybrid Alternative would curve further to the north than the BNSF Bakersfield Alternative between Union Avenue and Mount Vernon Avenue, where the train's speed would decrease to between 125 and 150 mph.

Barrier 1 for the Bakersfield Hybrid Alternative would be built on the southbound side of the alignment from north of Jomani Drive to north of Palm Avenue. The total length of the barrier would be approximately 10,144 feet, and the height would be 14 feet. This barrier would benefit approximately 224 severe-impact receivers.

Barrier 2 of the Bakersfield Hybrid Alternative would be built on the southbound side of the alignment from north of Palm Avenue to south of Coffee Road. The total length of the barrier would be approximately 8,453 feet, and the height would be 14 feet. This barrier would benefit approximately 971 residential receivers, of which 400 are severe-impact receivers, and 571 are moderate-impact receivers.

Barrier 3 of the Bakersfield Hybrid Alternative would be built on the southbound side of the alignment from east of Williams Street to Oswell Street. The total length of the barrier would be approximately 8,333 feet, and the height would be 14 feet. This barrier would benefit approximately 874 residential receivers, of which 194 are severe-impact receivers, and 680 are moderate-impact receivers.

Barrier 4 of the Bakersfield Hybrid Alternative would be built on the northbound side of the alignment from north of Jomani Drive to south of Palm Avenue. The total length of the barrier would be approximately 10,720 feet, and the height would be 14 feet. This barrier would benefit approximately 1,791 residential receivers, of which 164 are severe-impact receivers, and 1,627 are moderate-impact receivers.

Barrier 5 of the Bakersfield Hybrid Alternative would be built on the northbound side of the alignment from south of Palm Avenue to west of Coffee Road. The total length of the barrier would be approximately 5,035 feet, and the height would be 14 feet. This barrier would benefit approximately 211 receivers, of which 30 are severe-impact receivers, and 181 are moderate-impact receivers.

Barrier 6 of the Bakersfield Hybrid Alternative would be built on the northbound side of the alignment from west of Oak Street to east of B Street. The total length of the barrier would be

approximately 3,851 feet, and the height would be 14 feet. This barrier would benefit approximately 63 receivers, all of which are severe-impact receivers.

Barrier 7 of the Bakersfield Hybrid Alternative would be built on the northbound side of the alignment from East of Washington Street to Oswell Street. The total length of the barrier would be approximately 8,813 feet, and the height would be 14 feet. This barrier would benefit approximately 937 receivers, of which 309 are severe-impact receivers, and 628 are moderate-impact receivers.

A total of 95 severe noise impact sites along the western and eastern sides of this section would not benefit from these barriers; due to the specific site geometry, these receivers would receive less than a 5 dB reduction from the recommended noise barriers. The sound barrier results are presented in Table 3.4-32. Additional mitigation in the form of building insulation or payment of property noise easements would be implemented to reduce impacts at sensitive receivers not protected by sound barriers.

### ***Heavy Maintenance Facility Alternatives***

All the HMF site alternatives for the Fresno to Bakersfield Section are along the BNSF Alternative. The proposed sound barriers for these locations are shown on Figures 3.4-14 through 3.4-19.

### ***Schools***

With implementation of the proposed sound barriers only the College of the Sequoias along the Hanford West Bypass 1 and 2 at-grade alternatives would experience severe noise impacts as no sound wall is proposed along those alternatives.

**N&V-MM#4: Vehicle noise specification.** In the procurement of an HST vehicle technology, the Authority will require bidders to meet the federal regulations (40 CFR Part 201.12/13) at the time of procurement for locomotives (currently a 90-dB-level standard), for cars operating at speeds of greater than 45 mph). Depending on the available technology, this could significantly reduce the number of impacts throughout the corridor.

**N&V-MM#5: Special trackwork at crossovers and turnouts.** Because the impacts of HST wheels over rail gaps at turnouts increases HST noise by approximately 6 dB over typical operations, turnouts can be a major source of noise impact. If the turnouts cannot be moved from sensitive areas, the project can use special types of trackwork that eliminate the gap.

**N&V-MM# 6: Additional noise analysis following final design.** If final design or final vehicle specifications result in changes to the assumptions underlying the noise analysis, reassess noise impacts and recommendations for mitigation, and provide supplemental environmental documentation, as required by CEQA and NEPA.

**N&V-MM#7: Heavy maintenance facilities.** In order to reduce the noise from the heavy maintenance facilities, the following noise mitigation measures are recommended:

- Enclose as many of the maintenance activities within the facility as possible.
- Eliminate windows in the maintenance building that would face toward noise sensitive land uses adjacent to the facility. If windows are required to be located on the side of the facility facing noise-sensitive land uses, they should be the fixed type of windows with a sound transmission class (STC) rating of at least 35. If the windows must be operable, they should be closed during nighttime maintenance activities.

- Close maintenance facility doors where the rails enter the facility during nighttime maintenance activities.
- Maintenance tracks that cannot be located within the maintenance facility should be located on the far side of the facility from adjacent noise-sensitive receivers.
- For maintenance tracks that cannot be installed away from noise-sensitive receivers, install sound barrier along the maintenance tracks in order to protect the adjacent noise-sensitive receivers.
- All mechanical equipment (compressors, pumps, generators, etc.) should be located within the maintenance facility structure.
- Any mechanical equipment located exterior to the maintenance facility (compressors, pumps, generators, etc.) should be located on the far side of the facility from adjacent noise-sensitive receivers. If this is not possible, this equipment should be located within noise enclosures to mitigate the noise during operation.
- All ventilation ducting for the maintenance facility should be pointed away from the adjacent noise-sensitive receivers.

**Vibration**

**N&V-MM#8: Implement Proposed California High-Speed Train Project Noise and Vibration Mitigation Guidelines.** For existing rail, adequate wheel and rail maintenance are very important in preventing vibration impacts. Rough wheels and rails can increase vibration levels by as much as 20 VdB, which can negate any vibration control measures. It is rare when practical vibration control measures provide up to 15 to 20 VdB in attenuation. When possible, it is best to grind rough or corrugated rail and implement wheel truing to restore the wheel surface and contour. This may reduce vibration more than completely replacing the existing track system with floating slabs.

If the train, railway and railway structures are in good condition, then other mitigation methods must be examined. Mitigation will fit into one of the categories found in Table 3.4-33. The table lists where the mitigation procedure will take place. Mitigation can take place at the source, sensitive receiver, or along the propagation path from the source to the sensitive receiver. A description of each type of mitigation procedure can also be found in Table 3.4-33.

**Table 3.4-33**  
 Potential Vibration Mitigation Procedures and Descriptions

| Mitigation Procedure                     | Location of Mitigation | Description   |
|--|------------------------|---|
| Maintenance                              | Source                 | Rail condition monitoring systems with rail grinding on a regular basis. Wheel-truing to re-contour the wheel, provide a smooth running surface and remove wheel flats. Reconditioning vehicles. Installing wheel-condition monitoring systems.                         |
| Location and Design of Special Trackwork | Source                 | Careful review of crossover and turnout locations during the preliminary engineering stage. When feasible, relocate special trackwork to a less vibration-sensitive area. Installation of spring frogs eliminates gaps at crossovers and helps reduce vibration levels. |
| Vehicle Suspension                       | Source                 | Rail vehicle should have low unsprung weight, soft primary suspension, minimum metal-on-metal contact between moving parts of the truck, and smooth wheels that are perfectly round.  |

**Table 3.4-33**  
 Potential Vibration Mitigation Procedures and Descriptions

| Mitigation Procedure          | Location of Mitigation           | Description   |
|-------------------------------|----------------------------------|---|
| Special Track Support Systems | Source                           | Floating slabs, resiliently supported ties, high resilience fasteners and ballast mats all help reduce vibration levels from track support system.  |
| Building Modifications        | Receiver                         | For existing buildings, if vibration-sensitive equipment is affected by train vibration, the floor upon which the vibration-sensitive equipment is located could be stiffened and isolated from the remainder of the building. For new buildings, the building foundation should be supported by elastomer pads similar to bridge bearing pads.         |
| Trenches                      | Along Vibration Propagation Path | A trench can be an effective vibration barrier if it changes the propagation characteristics of the soil. It can be open or solid. Open trenches can be filled with styrofoam. Solid barriers can be constructed with sheet piling, rows of drilled shafts filled with either concrete or a mixture of soil and lime, or concrete poured into a trench. |
| Operational Changes           | Source                           | Reduce vehicle speed. Adjust nighttime schedules to minimize train movements during sensitive hours. Operating restrictions requires continuous monitoring and may not be practical.  |
| Buffer Zones                  | Receiver                         | Negotiate a vibration easement from the affected property owners or expand rail right-of-way.   |

The above mitigation measures for noise and vibration are commonly used approaches on similar scale transportation projects in the U.S. and internationally and have proven to be effective in minimizing potential impacts. Mitigation measures provided for construction noise and vibration are consistent with the mitigation measures given in the FRA guidance manual (FRA 2005) (Section 10.1.3, Mitigation of Construction Noise and Section 10.2.3, Construction Vibration Mitigation). Mitigation measures provided for operational noise and vibration impacts are also consistent with the mitigation measures given in the FRA guidance manual (Section 5.4, Mitigation of Noise Impact, and Section 9.4, Vibration Mitigation) and are commonly used to mitigate potential impacts from HST systems in the U.S. and internationally (e.g., Japan, China, Europe).

**Traffic Noise Impacts**

Several single-family homes will be subject to traffic peak-hour noise levels in excess of 66 dBA  $L_{eq}$ , and as a result, would exceed the Caltrans Noise Abatement Approach Criteria, and potentially requiring the preparation of Noise Study Reports and noise mitigation measures. FHWA highway traffic noise regulation requires, among other factors, the feasibility of the noise mitigation measure, as well as the consideration of the viewpoints of the impacted residents and property owners, in determining the reasonableness of abatement. Feasibility generally deals with considering whether it is possible to build an abatement measure, given site constraints; whether the abatement measure provides a minimum reduction in noise levels; and that all of the homes potentially affected face the roadway from which the noise emanates. As a result, noise mitigation measures would be infeasible for any home with a driveway for which access must be maintained. The noise barrier would not be continuous, and subsequently would not provide the minimum 5 dB of noise reduction. A noise abatement measure is not feasible unless the measure achieves a noise reduction of at least 5 dBA for front-row receivers. Highway noise barriers are designed to protect areas of "frequent human use," which generally does not include the front yards of homes. Caltrans also does not generally put noise barriers across the front

yards of homes, because they are acoustically infeasible, and most homeowners wish to maintain their views from the fronts of their homes.

### **Secondary Impacts**

Secondary impacts could potentially occur at the locations where the project would install sound barriers. The changes to visual and aesthetic qualities and the existing environment that might occur because of the installation of these barriers are covered in Chapter 3.16, Aesthetics and Visual Resources, but these changes are not assessed in site-specific locations because of uncertainty about the locations of these barriers, their heights, and their applications. The project design will incorporate communities' input on the appearance of the sound barriers to reduce secondary impacts. Sound barriers would not be additional obstacles to wildlife movement because they would be installed inside the fenced HST right-of-way.

Localized effects could occur from digging a trench to protect residences that would be affected by vibration.

### **3.4.8 NEPA Impacts Summary**

This section summarizes impacts identified in Section 3.4.5, Environmental Consequences, and evaluates their significance according to NEPA. Under NEPA, project effects are evaluated based on the criteria of context and intensity. The following impacts were identified under the No Project Alternative and the HST Project alternatives.

Under the No Project Alternative, economic growth is anticipated, which would result in growth in traffic and freight train movements. Although much of the project area currently experiences noise due to highway and freight traffic, increases of 3 dBA, which would only occur with a doubling of all current highway and freight traffic, are not likely to occur. Therefore, the increases in noise are likely to remain of negligible intensity and not significant under NEPA.

Construction of large transportation projects often generates noise and vibration complaints even though they only take place for a limited time. Vibration during construction would occur within 175 feet or less, but alternative techniques can substantially eliminate vibration impacts during construction. These impacts would be temporary during construction. For residences within 141 feet of the alignment, or within 446 feet during nighttime, construction impacts would have moderate intensity under NEPA; but due to the temporary nature, and with construction-period mitigation, construction noise and vibration impacts would not be significant under NEPA for all alternatives.

If an increase in noise level is considered highly annoying by the general population, it would be considered a severe impact under FRA criteria. Based on FRA noise criteria, the magnitude of the noise increase from the HST Project would result in impacts with substantial intensity. The range of sensitive receptors severely impacted at full system operations is from 1,945 to 5,069 depending on the combination of alternative alignments selected to provide a single alignment from Fresno to Bakersfield. Those alternatives that cross predominantly rural agricultural lands, such as the Corcoran Bypass, Allensworth Bypass, and Wasco-Shafter Bypass, would have substantially fewer severe noise impacts than alternatives that traverse urban areas. The Bakersfield Hybrid Alternative, which is located in more commercial and industrial areas than the other two Bakersfield alternatives, would reduce severely impact sensitive receivers by 1,987 for the BNSF Alternative; and 2,446 for the Bakersfield South Alternative. With full implementation of the *Proposed California HST Project Noise and Vibration Mitigation Guidelines* (see Appendix 3.4-A), most substantial noise impacts would be eliminated. Severe noise effects would remain for some receivers because they are located outside of the area where a sound barrier is fully effective, or the sound barrier does not fully mitigate the effect (i.e., noise is reduced by 4 dB, but not below the severe threshold). Furthermore, severe noise effects would remain for receivers mitigated only with indoor sound insulation, or when covered by noise easements. Due



to the degree of change in the residential areas (many in rural areas where quiet is expected) by such high numbers of receivers, these impacts would be significant under NEPA.

Vibration impacts are projected for all project alternatives. Vibration effects would be noticeable but are not anticipated to result in property damage. These impacts would be significant under NEPA because there is only one level of impact in the FRA criteria; therefore, all project vibration impacts are considered to be of substantial intensity under NEPA. Mitigation at these locations may not be feasible. If mitigation is not feasible, the project effect may result in property acquisition, thereby eliminating the effect.

The noise associated with increased traffic at HST stations would be considered to have moderate intensity at a few residences fronting major roads. These effects can be mitigated with building insulation. These residences already experience noise effects from adjacent highways, roadways; and in some cases, freight trains along the BNSF Railway. With mitigation, these impacts are not considered significant under NEPA.

### 3.4.9 CEQA Significance Conclusions

Table 3.4-34 summarizes noise- and vibration-related impacts, their associated mitigation measures, and the level of significance after mitigation. Under CEQA, significant impacts remain after mitigation because some noise-sensitive receivers might still experience operational noise levels that are considered severe even after installation of sound barriers. Also, in collaboration with the communities, some severe noise effects may not be mitigated if barriers are found to be unwanted. Additional mitigation may be necessary, including N&V-MM#4, to further reduce impacts. The number of impacts for the alternatives under Impact N&V#3 are the difference (plus or minus) between that alternative (e.g., Bakersfield South Alternative) compared with the corresponding segment of the BNSF Alternative.

**Table 3.4-34**  
 Summary of Potential Impacts from Noise and Vibration

| Impact  | CEQA Level of Significance before Mitigation | Mitigation Measure        | CEQA Level of Significant after Mitigation  |
|---|--|---------------------------|---|
| <b>Construction</b>   |  |                           |   |
| <b>N&amp;V#1:</b> Construction Noise  | Significant                                  | N&V-MM#1                  | Less than significant   |
| <b>N&amp;V#2:</b> Construction Vibration  | Significant                                  | N&V-MM#2                  | Less than significant   |
| <b>Project</b>  |  |                           |   |
| <p><b>N&amp;V#3:</b> Project Noise Impacts</p> <p>BNSF Alternative: 9,449 moderate and 4,507 severe impacts</p> <p>Impacts relative to the corresponding segment of the BNSF Alternative are as follows:</p> <p>Hanford West Bypass 1 (At-Grade): 260 moderate and 54 severe impacts</p> <p>Hanford West Bypass 1 (Below-Grade): 40 moderate and 53 severe impacts</p> <p>Hanford West Bypass 2 (At-Grade): 242 moderate and 74 severe impacts</p> <p>Hanford West Bypass 2 (Below-Grade): -14 moderate and 109 severe impacts</p> <p>Corcoran Elevated Alternative: 102 moderate and 31 severe impacts</p> <p>Corcoran Bypass Alternative: -554 moderate and -311 severe impacts</p> <p>Allensworth Bypass: -30 moderate and -14 severe impacts</p> <p>Wasco-Shafter Bypass: -1,815 moderate and -1,101 severe impacts</p> <p>Bakersfield South: -201 moderate and 422 severe impacts</p> <p>Bakersfield Hybrid: -2,258 moderate and -1,136 severe impacts</p> | Significant                                  | N&V-MM#3 through N&V-MM#6 | <p>Significant in some locations, maximum remaining severe impacts detailed below:</p> <p>Less than significant where fully mitigated</p> <p>BNSF: 902 severe impacts</p> <p>Impacts relative to the corresponding segment of the BNSF Alternative are as follows:</p> <p>Hanford West Bypass 1 (At-Grade): 54</p> <p>Hanford West Bypass 1 (Below-Grade): 53</p> <p>Hanford West Bypass 2 (At-Grade): 74</p> <p>Hanford West Bypass 2 (Below-Grade): 109</p> <p>Corcoran Elevated: -52 impacts</p> <p>Corcoran Bypass Alternative: 32 impacts</p> <p>Allensworth Bypass: 0 impacts</p> <p>Wasco-Shafter Bypass: 233 impacts</p> <p>Bakersfield South: 50 impacts</p> <p>Bakersfield Hybrid: 82 Impacts</p> |

**Table 3.4-34**  
 Summary of Potential Impacts from Noise and Vibration

| Impact  | CEQA Level of Significance before Mitigation | Mitigation Measure  | CEQA Level of Significant after Mitigation |
|---|--|---------------------|--|
| <p><b>N&amp;V#5: Project Vibration Impacts</b><br/>                     BNSF Alternative: 40 impacts<br/>                     Impacts relative to the corresponding segment of the BNSF Alternative are as follows:<br/>                     Hanford West Bypass 1 (At-Grade): -4 impacts<br/>                     Hanford West Bypass 1 (Below-Grade): -6 impacts<br/>                     Hanford West Bypass 2 (At-Grade): -2 impacts<br/>                     Hanford West Bypass 2 (Below-Grade): -4 impacts<br/>                     Corcoran Elevated Alternative: 11 impacts<br/>                     Corcoran Bypass Alternative: 9 impacts<br/>                     Allensworth Bypass: -2 impacts<br/>                     Wasco-Shafter Bypass: -3 impacts<br/>                     Bakersfield South: same impacts<br/>                     Bakersfield Hybrid: 20 impacts</p> | <p>Significant</p>                           | <p>N&amp;V-MM#8</p> | <p>Potentially significant</p>             |

*This page intentionally left blank*