Removing all potential remaining horn noise would not eliminate noise impacts, however, because the sound of the trains would remain. The proposed HST would add its own noise to that of other trains using the railroad corridor. Carrying the focused study further, it was found that approximately 75% of the grade crossings to be eliminated with the proposed HST are located adjacent to residential areas with a high potential noise impact rating. There would be a clear benefit from the elimination of the horns and warning signals. While with the HST, there would be additional train noise and vibration primarily from the high train speed and frequency of service.

Based on these results, the potential noise impact ratings from screening were adjusted to account for segments where grade crossings would be eliminated for existing passenger and freight trains as part of the implementation of HST service along that segment. A reduction in one impact rating level (high to medium or medium to low) was made only for segments where HST speeds would be less than 150 mph (241 kph). Where speeds are above that level, no adjustment was made since the noise created by the proposed new service at higher speeds would likely overshadow the reduction in horn and bell noise due to grade separation.

This adjustment was made on the segments listed below.

- Caltrain corridor from San Francisco to San Jose.
- Hayward/Niles/Mulford Line from south of Oakland to north of Union City.
- Metrolink/UPRR from south of Sylmar to Burbank.
- LOSSAN from Fullerton to Irvine.

Costs and Benefits of a High-Speed Bypass Loop

The HST Alternative has rail alignment options that would allow express trains to bypass certain intermediate stations in urban centers. Such bypass tracks are referred to as express loops. The costs and benefits of express loops are based on the analysis of one line through the city (express tracks and off-line station tracks) versus two lines for the city (line through the city for stopping trains at reduced speeds < 125 mph [200 kph] and express tracks bypassing the urban area at high speeds). Without a high-speed loop, there is a greater potential for noise impacts on people in urban areas because of the higher speed of express trains, the greater number of trains, and the greater density of people along urban alignments. Express loops considered skirt the populated areas of several cities in the Central Valley, including Modesto, Atwater, Merced, Fresno, and Tulare. A noise analysis for the Sacramento to Bakersfield region was used to quantify and compare the differences between the two configurations, i.e., with and without high-speed loops.

The high-speed loop that skirts Fresno was chosen as an example to illustrate the potential noise benefits that might be obtained by implementing high-speed loops. The focused evaluation compares the number of people impacted by the option without the loop and the number of people impacted by the option that includes the high-speed loop around Fresno. Fresno has two potential high-speed loops, depending on which of the two rail alignments is selected as the mainline HST route, Union Pacific Railroad (UPRR) or Burlington Northern Santa Fe (BNSF).

The screening distance used for the high-speed loop is the distance associated with express high-speed trains at a maximum operating speed of 220 mph (354 kph). With the high-speed loop included as part of the option, the screening distance used for the mainline is that associated with stopping or accelerating trains at the station, or speeds slower than 125 mph (201 kph). Using the GIS database, the numbers of people potentially impacted for the two scenarios were determined.

The UPRR alignment high-speed loop option analysis indicates that if express trains use the mainline track (no high-speed loop), the number of people potentially impacted by noise would be somewhat higher (16%) particularly in the downtown area compared to the number of people potentially impacted by including a high-speed loop. The BNSF high-speed loop option analysis indicates that 12% more people would be potentially impacted if all trains use the mainline compared with the high-speed loop option. This comparative evaluation shows that fewer people would be impacted by noise with the high-speed loop, although the difference would not be large. While the high-speed loops would reduce noise impacts along the HST line through the urban center, the implementation of two lines (express loop and stopping tracks in the city) creates some additional noise impacts around the outskirts of the urban area and would affect a greater total area. The marginal reduction in potential noise impact in the urban locations from using an express (high-speed) loop might be achieved at a lower cost through noise barrier mitigation of the direct route in which all the trains (both stopping and express trains) pass through all the stations in urban areas.

3.4.2 Affected Environment

A. STUDY AREA DEFINED

The study area for the noise and vibration assessment is defined by the screening distances that are used by the FRA (U.S. Department of Transportation 1998) and FTA (U.S. Department of Transportation 1995) to evaluate rail and highway corridors. Rail and highway study areas are within 1,000 ft (305 m) of the centerline of the alignment options for each alternative. For airport noise in California, the study area is the area within the 65-decibel (dB) CNEL noise contour established for the particular airport. This is the extent of the area where a change in noise would be most noticeable to receptors, and noise impacts from new projects could begin to dominate the noise environment.

B. GENERAL DISCUSSION OF NOISE AND VIBRATION

This section describes the characteristics and associated terms and measurements used for transportation-related noise and vibration. When noise from a highway, plane, or train reaches a receptor, whether it is a person outdoors or indoors, it combines with other sounds in the environment (the ambient noise level) and may or may not stand out in comparison. The distant sources may include traffic, aircraft, industrial activities, or sounds in nature. These distant sources create a background noise in which usually no particular source is identifiable and to which several sources may contribute, but is fairly constant from moment to moment and varies slowly from hour to hour. Superimposed on this slowly varying background noise is a succession of identifiable noisy events of relatively brief duration. Examples include the passing of a train, the over flight of an airplane, the sound of a horn or siren, or the screeching of brakes. These single events may be loud enough to dominate the noise environment at a location for a short time, and when added to everything else, can be an annoyance. The descriptors used in the measurement of noise environments are summarized below.

The fundamental measure of noise is the dB, a unit of sound level based on the ratio between two sound pressures—the sound pressure of the source of interest (e.g., the HST) and the reference pressure (the quietest sound that a human can hear). Because the range of actual sound pressures is very large (a painful sound level can be over 1 million times the sound pressure of the faintest sound), the expression of sound is compressed to a smaller range with the use of logarithms. The resulting value is expressed in terms of dB. For example, instead of a sound pressure ratio of 1 million, the same ratio is 120 dB.

The human ear does not respond equally to high- and low- pitched sounds. In the 1930s, acoustical scientists determined how humans hear various sounds and developed response characteristics to

represent the sensitivity of a typical ear. One of the characteristics, called the *A-curve*, represents the sensitivity of the ear at sound levels commonly found in the environment. The A-curve has been standardized. The abbreviation dBA is intended to denote that a sound level is expressed as if a measurement has been made with filters in accordance with that standard.

- *Maximum Sound Level (L_{max})*, measured in dBA, is the highest noise level achieved during a noise event.
- *Equivalent Sound Level (L_{eq})*, measured in dBA, describes a receptor's cumulative noise exposure from all noise events that occur in a specified period of time. The hourly L_{eq} is a measure of the accumulated sound exposure over a full hour. The L_{eq} is computed from the measured sound energy averaged over an hour (nothing one would read from moment to moment on a meter) representing the magnitude of noise energy received in that hour. FHWA uses the peak traffic hour L_{eq} as the metric for establishing highway noise impact.
- *Day-Night Sound Level (L_{dn})* describes a receptor's cumulative noise exposure from all noise events that occur in a 24-hour period, with events between 10 p.m. and 7 a.m. increased by *10* dB to account for greater nighttime sensitivity to noise. The L_{dn} is used to describe the general noise environment in a location, the so-called "noise climate." The unit is a computed number, not one to be read from moment to moment on a meter. Its magnitude is related to the general noisiness of an area. EPA developed the L_{dn} descriptor and now most federal agencies, including the FRA, use it to evaluate potential noise impacts. Typical L_{dns} in the environment are shown in Figure 3.4-1.
- *CNEL*, a variant of Ldn, is used in noise assessments in California. Rather than dividing the day into two periods, daytime and nighttime, CNEL adds a third to account for increased sensitivity to noise in the evening when people are likely to be engaged in outdoor activities around the home. An evening addition of 5 dB is applied to noise events between the hours of 7 p.m. and 10 p.m. to reflect the additional annoyance noise causes at that time. In general, the difference between Ldn and CNEL is slight and the two measures will be considered interchangeable for purposes of this noise analysis.

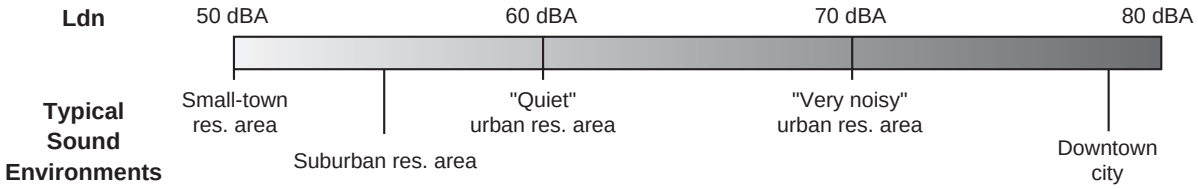
The way people react to noise in their environment has been studied extensively by researchers throughout the world. Based on these studies, noise impact criteria have been adopted by the FRA (U.S. Department of Transportation 1998) and other federal agencies to assess the contribution of the noise from a source like HST to the existing environment. The FRA bases noise impact criteria on the estimated increase in L_{dn} (for buildings with nighttime occupancy) or increase in L_{eq} (for institutional) buildings caused by the project for direct and indirect impacts. Criteria are discussed in Section 3.4.1 and Appendix 3.4-C.

Transportation Noise

Noise from highways, airports, and rail lines tends to dominate the noise environment in its immediate vicinity. Each mode has distinctive noise characteristics in both shape and source levels. Highway and rail noise affects an area that is linear in shape, extending to both sides of the alignment. Airport noise, in contrast, affects a closed area around the facility, with the shape of the closed loop determined by runway orientation.

Highway Noise and Vibration: Individual highway vehicles are generally relatively quiet, but the accumulation of noise from the volume of traffic throughout the majority of the day and night results in a nearly continuous high sound level. Noise from road traffic is generated by a wide variety of vehicle types, makes, and models. In general, the noise associated with highway vehicles can be divided into three classes of vehicle: automobiles, medium trucks, and heavy trucks. Each class has its own noise characteristic depending on vehicle type, speed, and the condition of the roadway surface.

Figure 3.4.1 Typical Day-Night Sound Level Environments



The cumulative effect of all the vehicles added together comprises the noise environment in the vicinity of a highway. The noise level along a highway facility is strongly influenced by the traffic flow—its speed and the number of vehicles of each type using it. Busy freeways have a nearly continuous noise, whereas rural roads have noise levels that rise and fall depending on clusters of traffic. Multi-lane freeways spread the noise sources out over many lanes, resulting in a large area affected by noise. However, highway noise is generated at or very near the ground surface so that topographical conditions at the roadside have a major effect on propagation. Highway noise is described as a line source, since the noise is generated along a long line of highway. Noise levels are mapped using contour lines for given noise levels and they are roughly parallel to the highway. While these contours are directly influenced by the width of the facility (number of lanes), the volume and speed of the traffic are the primary factors that influence the amount of noise and the location of the noise contour.

Vibration created by truck traffic can be felt in areas adjacent to highways. However, there are no established vibration criteria for highways and consequently highway vibration is not part of this analysis.

Aircraft and Airport Noise and Vibration: Airport noise sources can be among the loudest sounds in the environment, but the aircraft pass-bys tend to be rather short in duration and are concentrated along the alignments of the runways. The area of noise impact around an airport depends on the number of operations, the type of aircraft, and the flight tracks used at that airport. Noise near airports is generated by a complex sound source consisting of flight operations and ground operations. Flight operations associated with an airport include takeoffs and landings, requiring extra power, and increased noise levels. When the aircraft are airborne, they propagate sound to great distances. For airborne operations, sound reaching the ground depends highly on atmospheric conditions. Ground operations include aircraft taxiing, run-up operations, and surface transportation near the terminal and its runways. Noise generated by ground operations has to spread out over the ground, thereby being strongly affected by topographical conditions, vegetation, ground types, and buildings.

Noise levels can vary considerably for different types of aircraft, by type, engine power settings, and flight paths. As with highway noise, the cumulative effect of airport noise depends on the number of flight operations and runway utilization. As opposed to a highway where the source is linear in nature, an airport is described as an aerial source, affecting a defined area with closed contours around the airport. The noise contours tend to be elongated in the direction of the major runways.

Vibrations from aircraft, particularly low flying aircraft and their engines, can potentially impact homes and businesses; however since the FAA does not have a criteria for measuring these vibrations, it is not included in this analysis.

Conventional and High-Speed Train Noise and Vibration: While high-speed trains have some similar noise and vibration characteristics to conventional trains, they also have several unique features resulting from the reduced size and weight, the electrical power, and the higher speed of travel. The proposed HST would be a steel-wheel, steel-rail electrically-powered train operating in an exclusive right-of-way. Because there would be no roadway grade crossings, the annoying sounds of the train horn and warning bells would be eliminated. The use of electrical power cars would eliminate the engine rumble associated with diesel-powered locomotives. The above factors allow HST to generate lower noise levels than conventional trains at comparable speeds below 100 mph (161 kph). At higher speeds above 150 mph (241 kph), however, HST noise levels would increase over conventional trains due to aerodynamic effects. A mitigating factor is that high speeds would enable HST noise to occur for a relatively short duration

compared with conventional trains (a few seconds at the highest speeds versus 10 to 20 seconds for conventional passenger trains and over 1 minute for freight trains).

For the proposed HST system higher operating speeds of 150 to 220 mph (241 to 354 kph) would be planned for the less constrained areas, in terms of alignment (i.e., flat and straight). In contrast, much lower operating speeds <125 mph (201 kph) would be planned in the more developed areas. Figures 3.4-2 and 3.4-3 illustrate the maximum operating speeds for express service along each of the proposed HST alignment options. Local and semi-express services would not necessarily reach these maximum speeds because they would stop and start for more stations.

Noise from a high-speed train is expressed in terms of a source-path-receiver framework as illustrated in Figure 3.4-4. The source of noise is the train moving on its tracks. The path describes the intervening course between the source and the receptor wherein the noise levels are reduced by distance, topographical and human-made obstacles, atmospheric effects, and other factors. Finally, at each receptor, the noise from all sources combine to make up the noise environment at that location.

The total noise generated by a train is the combination of sounds from several individual noise-generating mechanisms, each with its own characteristics, including location, intensity, frequency content, directivity, and speed dependence. The distribution of noise sources on a typical HST is shown in Figure 3.4-5. These noise sources can be grouped into three categories according to the speed of the train.

For low speeds, below about 40 mph (64 kph), noise emissions are dominated by the propulsion units, cooling fans, and under-car and top-of-car auxiliary equipment such as compressors and air conditioning units. The HST would be electrically powered and considerable quieter at low speeds than conventional trains that are usually diesel powered.

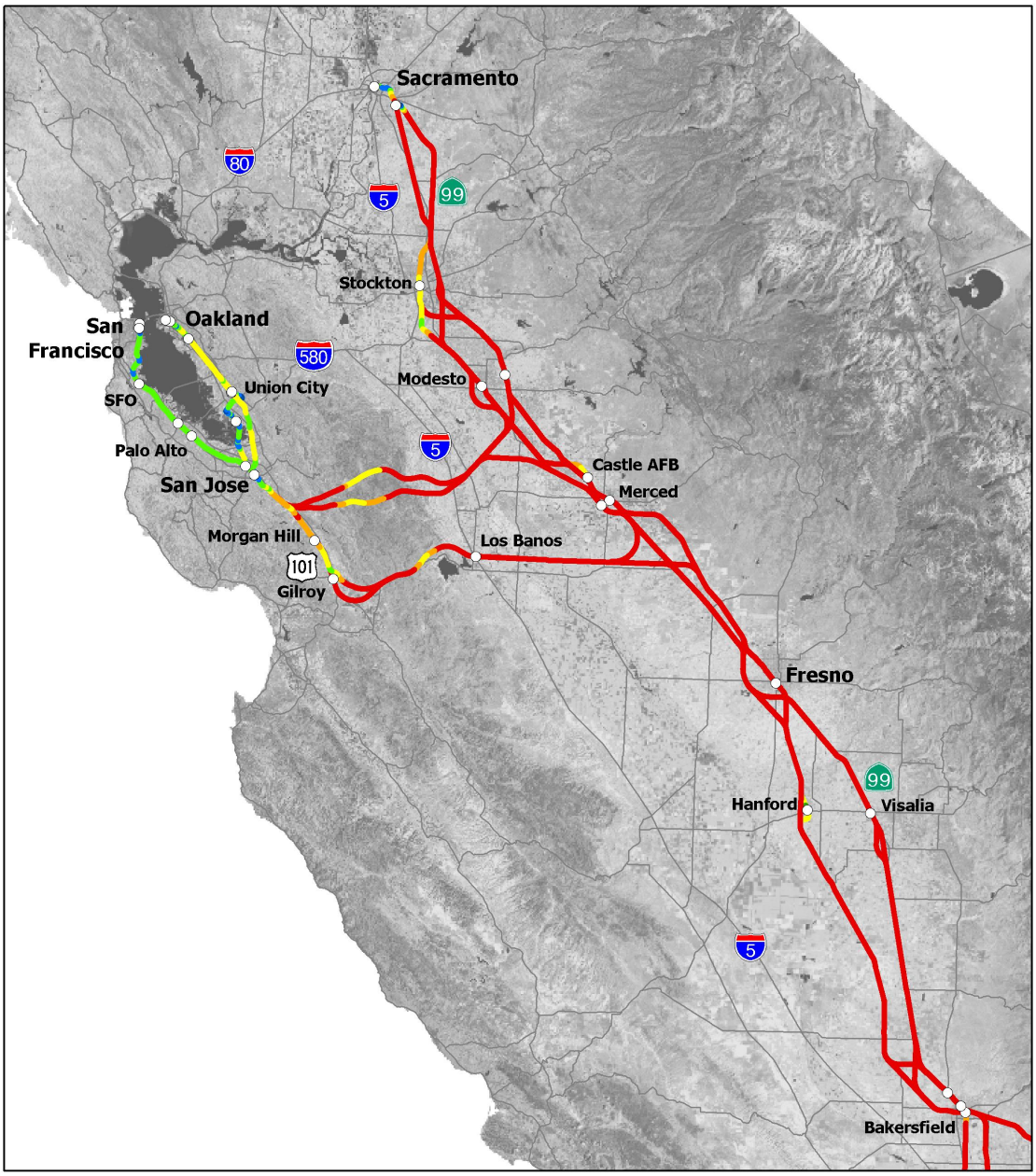
In the speed range from 60 mph to about 150 mph (98 kph to 241 kph), mechanical noise resulting from wheel/rail interactions and structural vibrations dominate the noise emission from trains. In the existing rail corridors within California, conventional trains seldom exceed 79 mph (127 kph), so this speed range, which represents a medium range for HST, is the top end of noise characteristics for trains with which most people are familiar. Speed has a strong influence on noise in the medium speed range.

Above approximately 170 mph (274 kph), aerodynamic noise sources tend to dominate the radiated noise from the HST. Conventional trains are not capable of attaining such speeds. HST noise in the transition speeds between each of the three foregoing ranges is a combination of the sources in each range.

Noise from HST also depends on the type and configuration of its track structure. Typical noise levels are expressed for HST at grade on ballast and tie track, the most commonly found track system. For trains on elevated structure, HST noise is increased, partially due to the loss of sound absorption by the ground and partially due to extra sound radiation from the bridge structure. Moreover, the sound from trains on elevated structures spreads about twice as far as it does from at-grade operations of the same train, due to raising the sound source higher above ground.

Horns are an example of a train noise source that is a dominant noise source at any speed. Audible warnings at grade crossings, including train horns and warning bells, are a common feature of conventional trains and a vital safety component of railroad operations. These noise sources often prove to be a source of annoyance to people living near railroad tracks. In the

Figure 3.4-2 Maximum Operating Speeds (Northern California)



September 23, 2003

California High Speed Train Program EIR/EIS

Legend

Speed Ranges

MPH	KPH
0 - 31	0 - 50
31 - 62	50 - 100
62 - 93	100 - 150
93 - 124	150 - 200
124 - 155	200 - 250
155 - 186	250 - 300
186 - 217	300 - 350

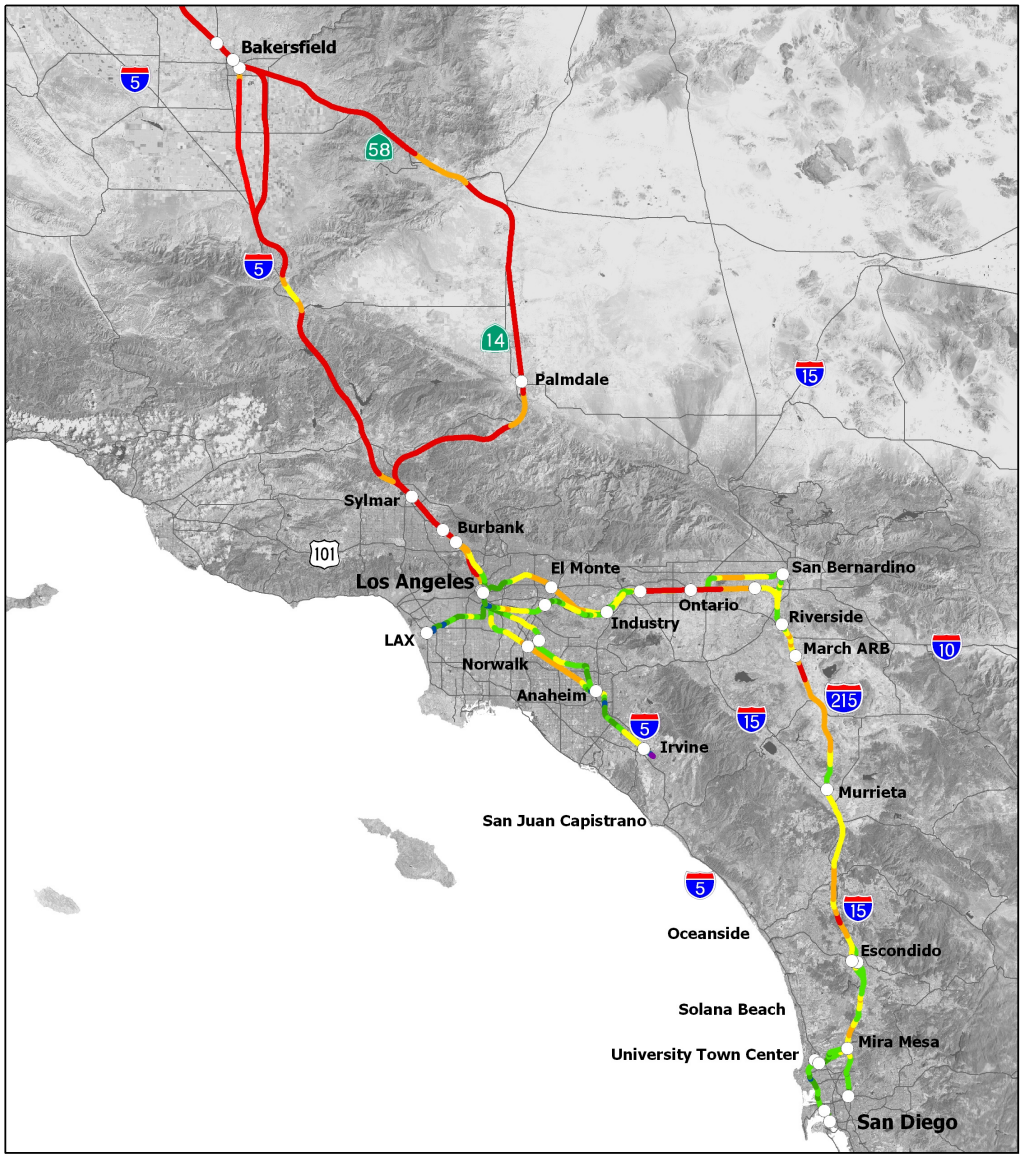
10 0 10 Miles

10 0 10 Kilometers

CALIFORNIA HIGH SPEED RAIL AUTHORITY

Express Trip Time Train Service Speeds Northern California

Figure 3.4-3 Maximum Operating Speeds (Southern California)



May 24, 2005

California High Speed Train Program EIR/EIS

10 5 0 10 20 Miles

10 5 0 10 20 Kilometers

CALIFORNIA HIGH SPEED RAIL AUTHORITY

Legend

Speed Ranges

MPH	KPH
0 - 31	0 - 50
31 - 62	50 - 100
62 - 93	100 - 150
93 - 124	150 - 200
124 - 155	200 - 250
155 - 186	250 - 300
186 - 217	300 - 350

Express Trip Time Train Service Speeds Southern California

Figure 3.4.4. HST Source-Path-Receiver Framework

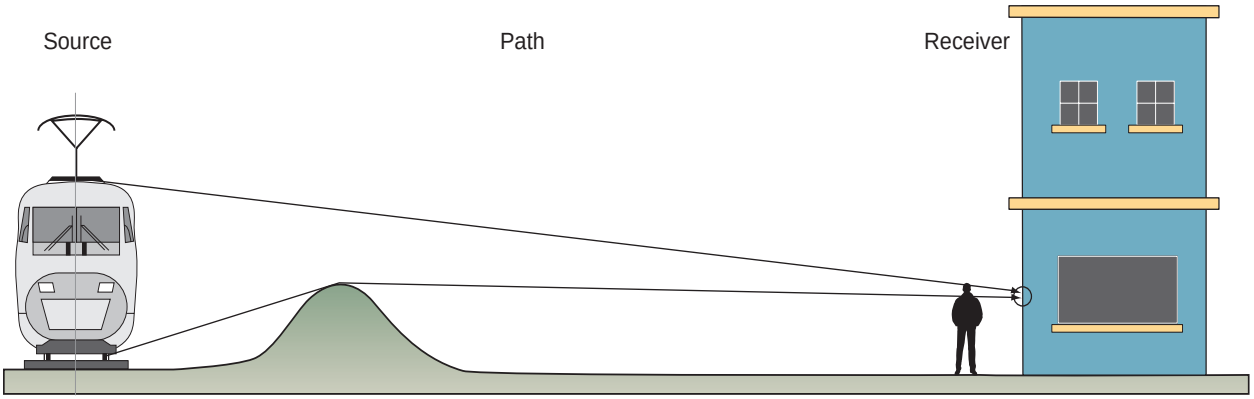
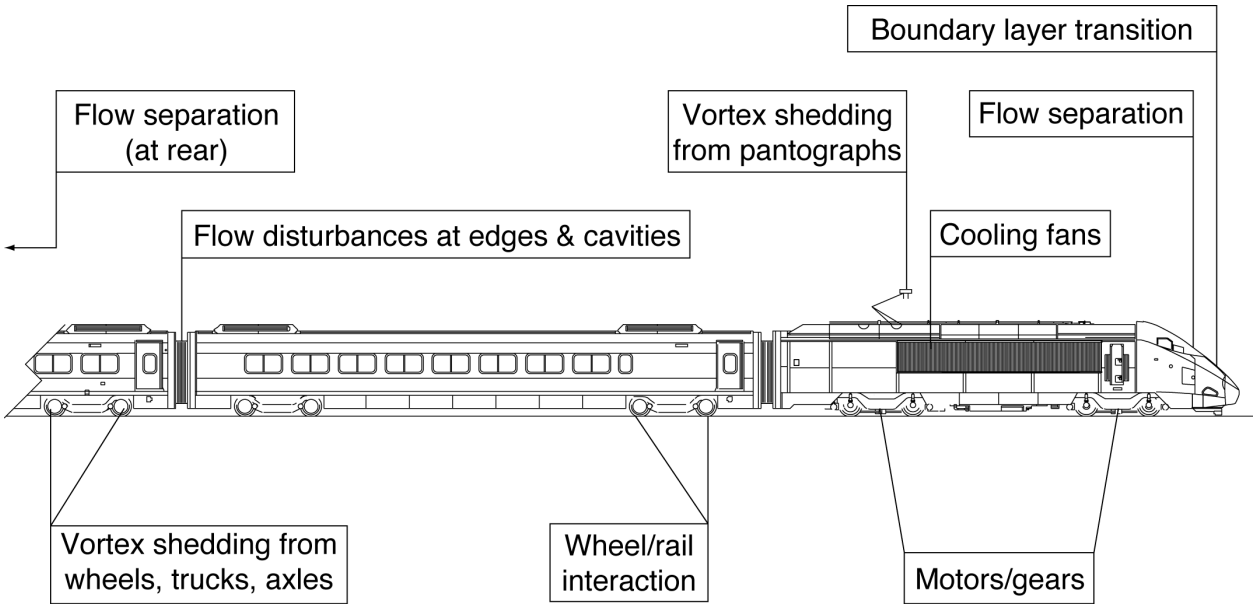


Figure 3.4-5. Noise Sources on HST



case of HST, however, horn and warning bell noise at grade crossings are absent except in the case of emergencies because grade crossings are eliminated for reasons of safety. Elimination of horns and bells at existing grade crossings would provide a noise benefit associated with the implementation of HST for alignments along existing rail corridors, but only in locations where grade separations also served the existing rail service, thereby removing the need for grade crossing warnings and train horns.

Vibration of the ground caused by the pass-by of the HST is similar to that caused by conventional steel wheel/steel rail trains. However, vibration levels associated with the HST are relatively lower than conventional passenger and freight trains due to new track construction and smooth track and wheel surfaces resulting from high maintenance standards required for high-speed operation.

Ground-borne vibration from trains refers to the fluctuating motion experienced by people on the ground and in buildings near railroad tracks. In general, people are not commonly exposed to vibration levels from outside sources that they can feel. Little concern results when a door is slammed and a wall shakes or something heavy is dropped and the floor shakes momentarily. Concern results, however, when an outside source like a train causes homes to shake. The effects of ground-borne vibration in a building located close to a rail line could at worst include perceptible movement of the floors, rattling of windows, shaking of items on shelves or hanging on walls, and rumbling sounds. None of these effects is great enough to cause damage, but could result in annoyance if repeated many times daily.

As with noise, ground-borne vibration can be understood as following a source-path-receptor framework, as shown in Figure 3.4-6. The source of vibration is the train wheels rolling on the rails. They create vibration energy that is transmitted through the track support system into the track bed or track structure. The path of vibration involves the ground between the source and a nearby building. The receptor of vibration is the building.

Mode Noise Level Comparisons

Noise levels of typical individual transportation vehicles are compared in Figure 3.4-7 with each other and with other commonly experienced sounds in the environment. Jet aircraft are clearly the noisiest of the transportation sources, followed by train horns and diesel trucks. Noise levels of high-speed trains at speeds of 100 to 150 mph (161 to 241 kph) are similar to that of freight and commuter trains at speeds of 50 to 80 mph (80 to 129 kph). The descriptor for the figure is the L_{max} which represents the highest sound level associated with a single event such as the passage of a train, aircraft, or truck.

As described above, the descriptor used in environmental assessments is the L_{dn}, which represents the cumulative noise exposure during a 24-hour period, rather than the L_{max}. A comparison of noise associated with surface transportation sources at various distances on either side of an unobstructed highway or railway is shown in Figure 3.4-8. This example is based on conventional passenger and freight trains at typical operating speeds compared with high-speed trains at a range of speeds, for a hypothetical situation of one train per hour. The graph shows the relative differences between these types and speeds of trains in terms of cumulative noise exposure. The graph also includes the cumulative noise levels over a 24-hour period of an 8-lane freeway with traffic traveling at 65 mph (105 kph) in relation to the train examples.

The graph in Figure 3.4-9 shows the difference in cumulative noise exposure for the same train types and speeds given typical frequency levels. In this case, since commuter trains and high-speed trains share many of the same noise profile characteristics (frequency, relative speed, and length) commuter trains and high-speed trains are assumed to have much higher frequencies than freight trains based on typical commuter operations and conceptual operating assumptions

Figure 3.4-6. Vibration Propagation from HST

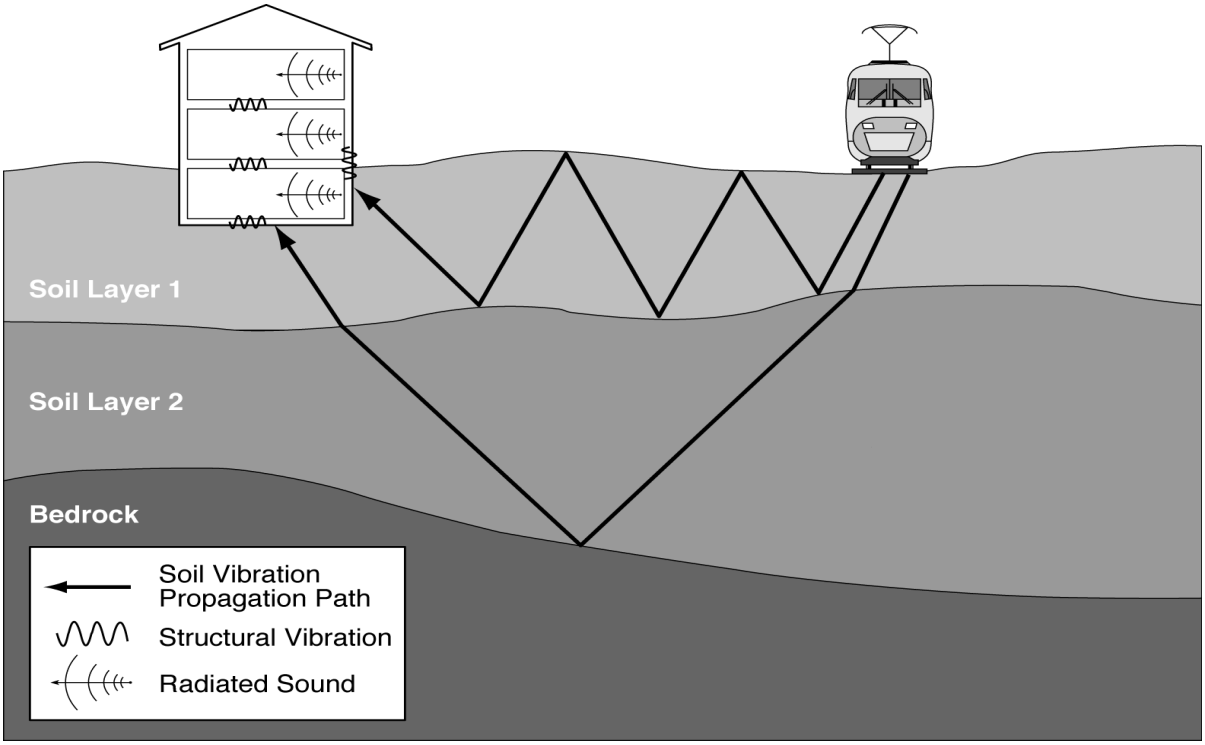


Figure 3.4-7. Typical Lmax Values

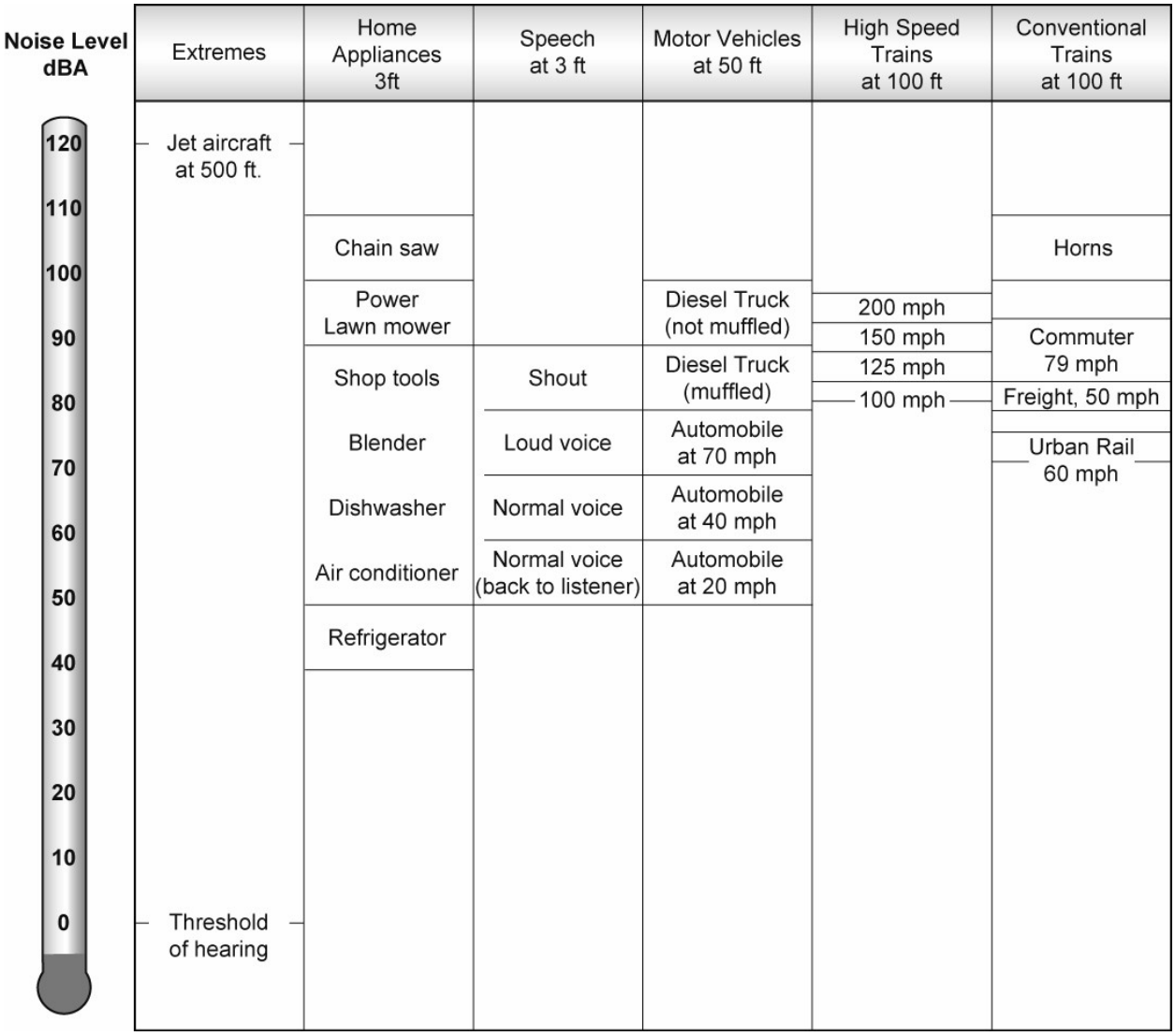


Figure 3.4-8 - Example of Noise Exposure vs. Distance with Normalized Frequency

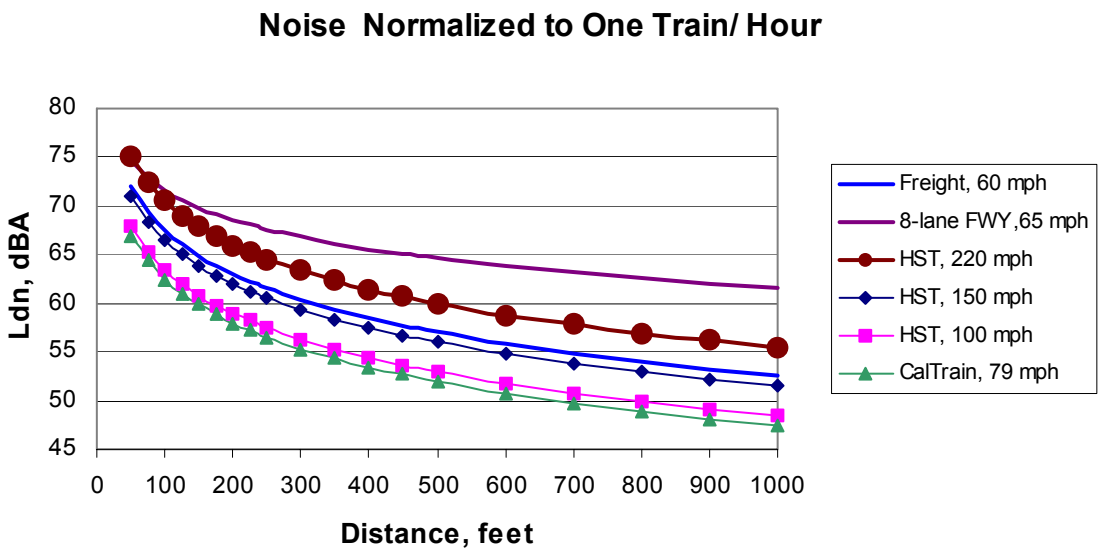
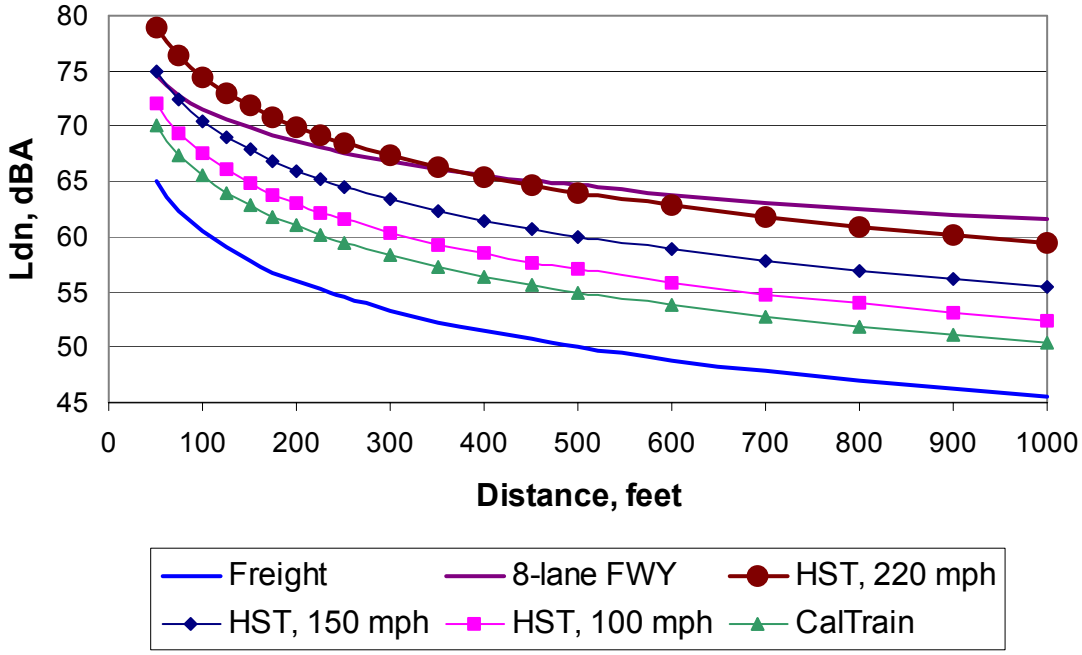


Figure 3.4-9 - Example of Noise Exposure vs. Distance with Typical Frequencies



for HST. For this illustration, HST is assumed to have 118 day and 14 night trains made up of 1 power car and 15 coaches; commuter trains are assumed to have 46 day and 28 night trains made up of 1 locomotive and 5 coaches; and freight trains are assumed to have 10 day and 3 night trains made up of 2 locomotives and 40 freight cars. The 8-lane freeway in this and the preceding plot is assumed to carry 1,885 vehicles/hour/lane with 2% medium trucks and 3% heavy trucks. This example shows that as frequencies and speeds are increased (e.g., the addition of HST trips) the noise exposure is increased relative to the existing conventional rail services. Again, the graph includes the cumulative noise levels of a typical 8-lane freeway with traffic traveling at 65 mph (105 kph) in relation to the train examples. This example also shows how the cumulative noise diminishes with distance from the linear-type surface transportation sources. In the first 300 ft (91 m) from the centerlines, L_{dn} from rail sources tends to diminish more with respect to distance than that from a busy freeway. The freeway constitutes a continuous long source of noise, whereas a rail line has a series of transient noise events with relatively short sources.

Because of its aerial nature, airport noise cannot be represented in the same format used for surface transportation sources. Contours of noise exposure surround the airport in an irregular pattern depending on the orientation of its runways and their use. The frequency of operations (takeoffs and landings) has a direct impact on the noise levels in the vicinity of the airports. The area within each contour grows with the number of operations of aircraft. For example, the area of the L_{dn} 65-dBA airport noise contour used as the impact criterion in FAA's planning guide increases 17% (affecting additional land area) for every 1.5-dB increase in L_{dn} (approximately a 40% increase in number of operations), according to FAA's area equivalent method.

C. NOISE ENVIRONMENTS BY REGION

Regional noise and vibration environments are generally dominated by transportation-related sources, including vehicle traffic on freeways, highways, and other major roads, existing passenger and freight rail operations, and aviation sources, including civilian and military. Existing noise along highway and proposed HST corridors has been estimated using data in the noise element from the general plan for cities and counties in the region, along with general methods provided by FHWA, FRA, and FTA for estimating transportation noise. Ambient noise levels are characterized for each region in the sections below. Ambient vibration conditions are very site-specific in nature and are not characterized as part of the program environmental process.

Bay Area to Merced

This region includes central California from the San Francisco Bay Area (San Francisco and Oakland) south to the Santa Clara Valley and east across the Diablo Range to the Central Valley. The ambient noise in the northern portion of the Bay Area to Merced region is dominated by motor vehicle traffic in densely populated areas and along freeways. All the regional freeways considered in the No Project and Modal Alternatives are major contributors to the ambient noise environment. In this region the potential HST alignments would primarily follow or parallel existing rail tracks. Along the proposed HST alignment on the San Francisco Peninsula, the existing Caltrain passenger service is a major contributor to the ambient noise levels, especially at grade crossings where horn noise dominates the noise environment within 0.25 mi (0.40 km) of the intersections. Along the proposed HST alignment in the East Bay, existing Amtrak passenger service and freight rail contribute to the ambient noise levels, with horns at grade crossings being a major factor. In southern San Jose and as far as Gilroy to the south, Caltrain, Amtrak, and freight rail are major contributors to the ambient noise levels.

In the urban areas and suburban areas of the East Bay, San Francisco Peninsula, and San Jose, the ambient noise is estimated to range from L_{dn} 57 to 66 dBA. In many of the residential areas close to the international airports at San Francisco (SFO), Oakland (OAK), and San Jose (SJC),

the ambient levels exceed L_{dn} 65 dBA. In the more rural areas of the region to the southeast, the ambient noise ranges from 52 to 57 dBA. Henry Coe State Park is characterized by a low ambient noise environment, approximately L_{eq} 40 dBA, being in a remote location and removed from transportation noise sources, except along SR-152, which is also part of the Modal Alternative.

Sacramento to Bakersfield

This region of central California includes a large portion of the Central Valley (San Joaquin Valley) from Sacramento south to Bakersfield. The proposed HST alignment options in the Sacramento to Bakersfield region primarily follow two major railroad alignments, UPRR and BNSF. Most of the UPRR corridor runs parallel to SR-99. The proposed UPRR alignment generally has more populated land use development than the one following BNSF. The highway improvements included in the Modal Alternative are primarily focused on SR-99 and I-5. These railroad lines and the highways are major contributors to the ambient noise environment.

The land use along the corridor corresponds to a quiet suburban or rural area, changing into a noisy suburban or urban area primarily inside of the city and town limits such as Fresno and Merced, in the middle and at Sacramento and Bakersfield on each end, where typical moderate to high noise levels exist. Due to the proximity of the existing railroad and highway corridors to the proposed alignment/improvement options, the non-developed areas or areas of low population density are also relatively noisy. The non-residential, rural, and quiet suburban areas along the alignment options and existing transportation corridors in this region correspond primarily to agricultural land use where low noise levels predominate. There are some commercial and industrial areas next to the alignments, but only within the boundaries of the towns and cities. Ambient levels are estimated to be between L_{dn} 50 to 58 dBA for rural and quiet suburban, and L_{dn} 60 to 68 dBA for noisy suburban urban areas.

Bakersfield to Los Angeles

This region of southern California encompasses the southern portion of the Central Valley south of Bakersfield, the mountainous areas between the Central Valley and the Los Angeles basin, and the northern portion of the Los Angeles basin from Sylmar to downtown Los Angeles. The ambient noise from Bakersfield to Sylmar is dominated by motor vehicle traffic along the I-5 corridor and by both motor vehicle traffic and freight and passenger trains throughout portions of the Antelope Valley option. From Sylmar to Los Angeles Union Station (LAUS) the ambient noise is dominated by motor vehicle traffic and near rail lines by freight and passenger trains. The ambient noise levels in the densely populated urban areas and areas near existing highways or rail corridors range from L_{dn} 58 to 67 dBA or even higher. In the more rural areas of the region, the ambient noise levels range from L_{dn} 50 to 53 dBA.

Los Angeles to San Diego via Inland Empire

This region of southern California includes the eastern portion of the Los Angeles basin from downtown Los Angeles east to the Riverside and San Bernardino areas and south to San Diego generally along the I-215 and I-15 corridors. Between Los Angeles and Riverside, the ambient noise environment in the study area is dominated by a combination of noise from freeways, major roads, and existing railroads. With close proximity to a freeway or rail line, the transportation noise will typically dominate the local noise environment. Ambient noise in these areas ranges from L_{dn} 58 to 68 dBA.

Along portions of the alternative corridors between Riverside and Escondido, which follow I-15 and I-215, freeway noise is the dominant component of the existing ambient noise. Although this portion of the region is fairly rural, ambient noise near the existing highways is high. The

most rural area of this portion is mountainous, where ambient noise ranges from L_{dn} 54 to 65 dBA.

The Escondido to San Diego portion of the Inland Empire region is less urban than the Los Angeles area, but major freeways and existing rail lines have similarly high local noise environments. Ambient noise in the Escondido to San Diego areas along the study corridors ranges from L_{dn} 55 to 68 dBA.

Los Angeles to San Diego via Orange County

This region includes the western portion of the Los Angeles basin between downtown Los Angeles and Los Angeles International Airport (LAX) and the coastal areas of southern California between Los Angeles and San Diego, generally following the existing I-5 highway corridor. The ambient noise in the northern portion of the region is dominated by motor vehicle traffic in densely populated areas and along freeways. Along the connection to LAX, and in particular near freeways, motor vehicle traffic dominates. Closer to the airport, aircraft noise becomes dominant.

Along the conventional rail alignment south from LAUS, existing passenger service (Amtrak, Metrolink, and Coaster) and freight rail contribute to the local noise. Throughout this portion of the region, roadway traffic also contributes to the ambient. Along the HST alignment, freight rail and motor vehicle traffic comprise the sources of ambient noise. Along the coast, local roadway traffic and passenger rail service contribute to the ambient noise conditions, most notably horn blowing at grade crossings. Freeway noise is the dominant noise source in this region.

In the urban areas and suburban areas of Los Angeles and northern Orange Counties, the ambient noise ranges from L_{dn} 63 to 68 dBA depending on the proximity to noise sources such as rail, roadway and airport. In the more suburban areas of the region, the ambient noise ranges from 58 to 63 dBA. Along the coast, the ambient noise environment ranges from L_{dn} 54 to 64 dBA depending on proximity to local noise sources.

3.4.3 Environmental Consequences

A. EXISTING CONDITIONS COMPARED TO NO PROJECT ALTERNATIVE

The No Project Alternative includes programmed and funded transportation improvements that will be implemented and operational by 2020 in addition to the existing conditions. These improvements are not major system-wide capacity improvements (e.g., major new highway construction or widening or additional runways) and will not result in a general improvement of intercity travel conditions across the study area.

For purposes of this analysis, it is assumed that there will be no additional noise and vibration impacts associated with the development of No Project as compared to existing conditions. The potential significant impacts associated with programmed projects would be addressed with mitigation measures in a manner consistent with existing conditions in accordance with the project-level environmental documents and approvals for the projects as prepared by the project sponsors. While the implementation of the No Project Alternative may result in some increases, any estimate of such increases would be speculative.

B. NO PROJECT ALTERNATIVE COMPARED TO MODAL AND HIGH-SPEED TRAIN ALTERNATIVES

The No Project Alternative is used as the basis for comparison. It is assumed that any improvements associated with the proposed Modal and HST Alternatives would be in addition to No Project conditions.

The relative level of potential noise impact for the Modal Alternative is illustrated in Figures 3.4-10 and 3.4-11. The figures show the relative noise impact in terms of high, medium and low categories for all of the potentially improved highway segments included in this alternative. The Modal Alternative has over 200 mi (322 km) of highway segments with potential for high noise impacts. The segments of high potential impact generally result from the high total traffic volumes (existing plus the representative demand) and the capacity improvements associated with the Modal Alternative, which result in increased speeds and wider facility cross sections. The segments with existing noise barriers are assumed to have less than high potential because most improvements would include noise walls.

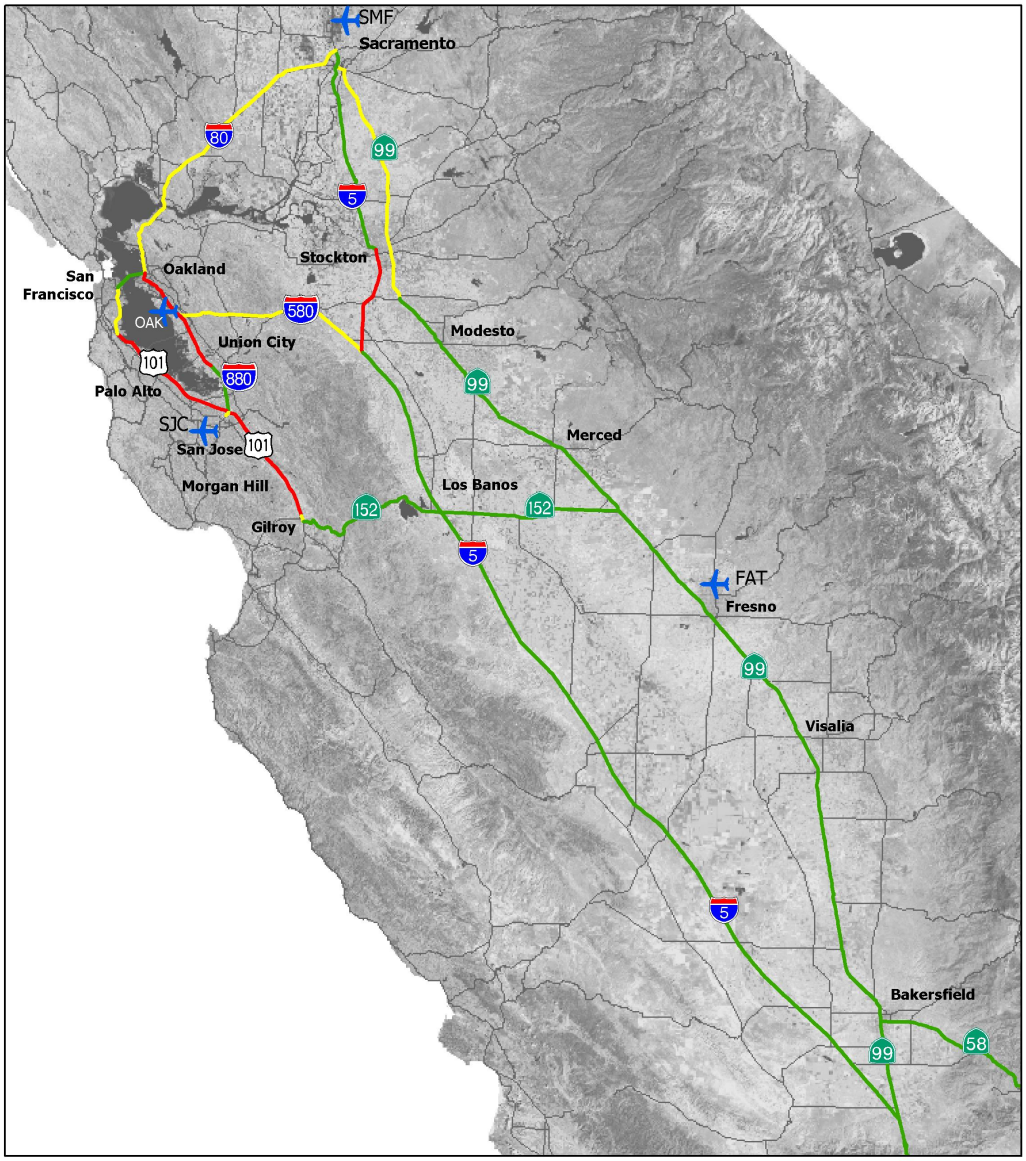
The noise levels for airports are not categorized as high, medium, and low. The available data indicate that the number of people affected by the aviation component is a small portion of the number affected by the Modal Alternative (see Appendix 3.4-D). Although aircraft and airport improvements contribute less to the Modal Alternative's potential noise impacts than the more extensive highway improvements, it should be acknowledged that noise from aircraft and airport operations can impact relatively large areas of land including large numbers of people surrounding the airport. Noise is one of the most prominent factors for the environmental acceptability of airport improvement or expansion and is often the limiting factor in the approval of such projects. There is typically strong community resistance to airport expansions due to noise issues. Many of the airports in urban areas like Burbank, San Jose, and Orange County all have operating restrictions based on the noise from the aircraft and the airport operations.

The relative level of potential noise impacts for the HST Alternative is illustrated in Figures 3.4-12 and 3.4-13. The figures show the relative noise impacts in terms of high, medium and low categories for all of the HST alignment options. The potential noise impact ratings account for the reduction of horn and bell noise associated with the elimination of grade crossings on existing rail lines, where appropriate.

The relative level of potential noise impact for each alternative is shown in Table 3.4-1 in terms of the total lengths of alignment (highway or HST) in each rating (high-medium-low) category. The sections of alignment options with high, medium, and low potential noise impact ratings for the HST Alternative are compared with the equivalent sections of the Modal Alternative. In addition, the potential impact ratings of HST alignments are shown without mitigation. The impact levels shown for the Modal Alternative assume that sound barriers (walls) are maintained or rebuilt along the segments of each improved highway where they currently exist. The results show the HST Alternative would have less total mileage of high potential for noise impact than the Modal Alternative. A full range of HST alignment options were assessed assuming a statewide system comprising the alignment options with the greatest potential for noise impact (GPI) and those with the least potential for noise impact (LPI).

Based on the percentage of total system-wide length that would experience potential high noise impacts, the HST Alternative is close to the Modal Alternative. For example, 14% of the improvements associated with the Modal Alternative are rated with a high potential for noise impact, whereas the HST Alternative ranges from 3% for LPI to 14% for GPI.

Figure 3.4-10
Potential Modal Alternative Noise Impact Levels-Northern California



Source: Landsat 1985 September 12, 2003

California High Speed Train Program EIR/EIS

10 5 0 10 20 30 40 Miles

105 0 10 20 30 40 Kilometers

CALIFORNIA HIGH SPEED RAIL AUTHORITY

Legend

Modal Alternative Noise Impacts

High

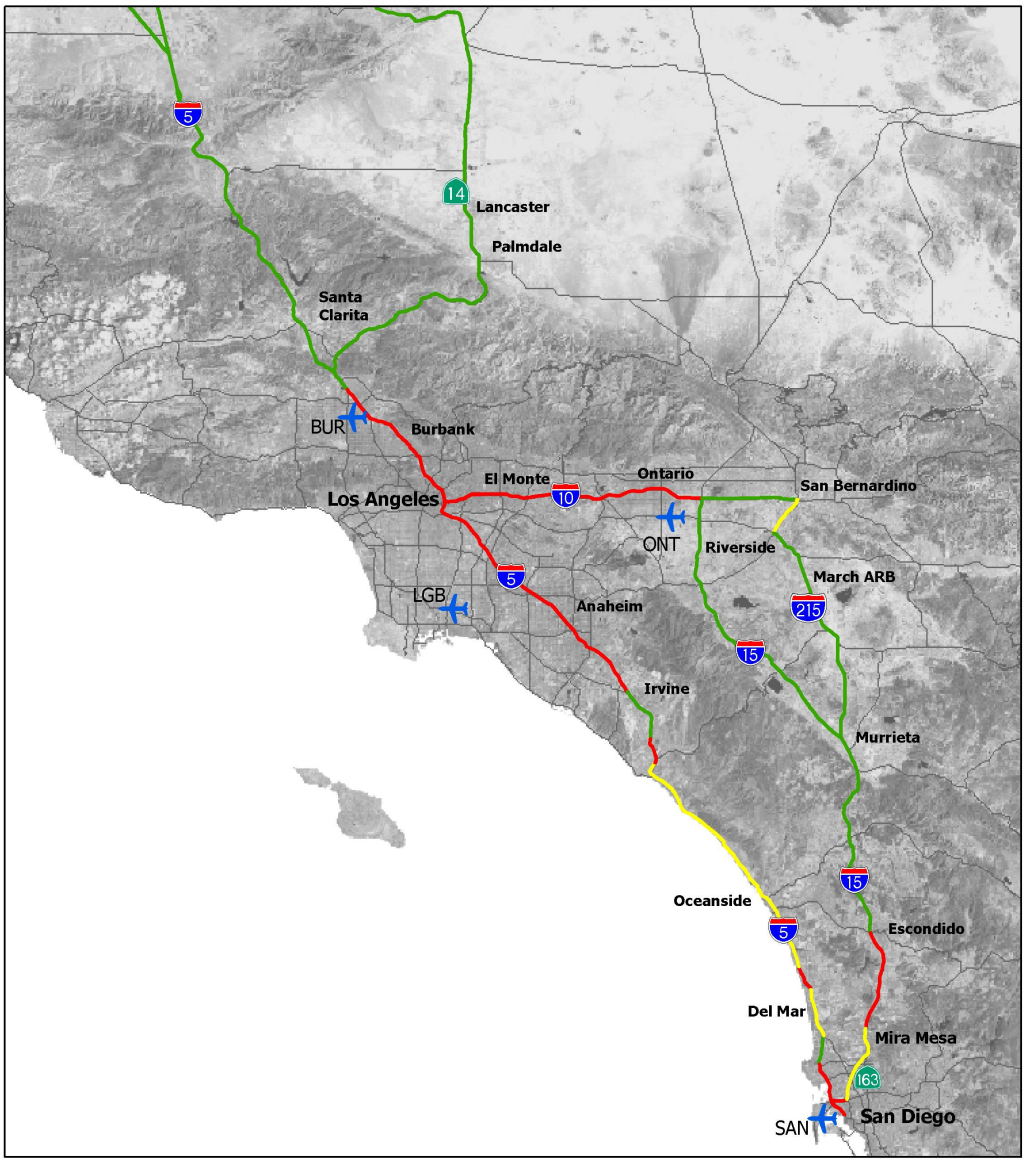
Medium

Low

FAT Modal Alternative Airports

Noise Impacts
Modal Alternative
Northern California

Figure 3.4-11
Potential Modal Alternative Noise Impact Levels-Southern California



Source: Landsat 1985 September 12, 2003

California High Speed Train Program EIR/EIS

Legend

Modal Alternative Noise Impacts

High

Medium

Low

FAT Modal Alternative Airports

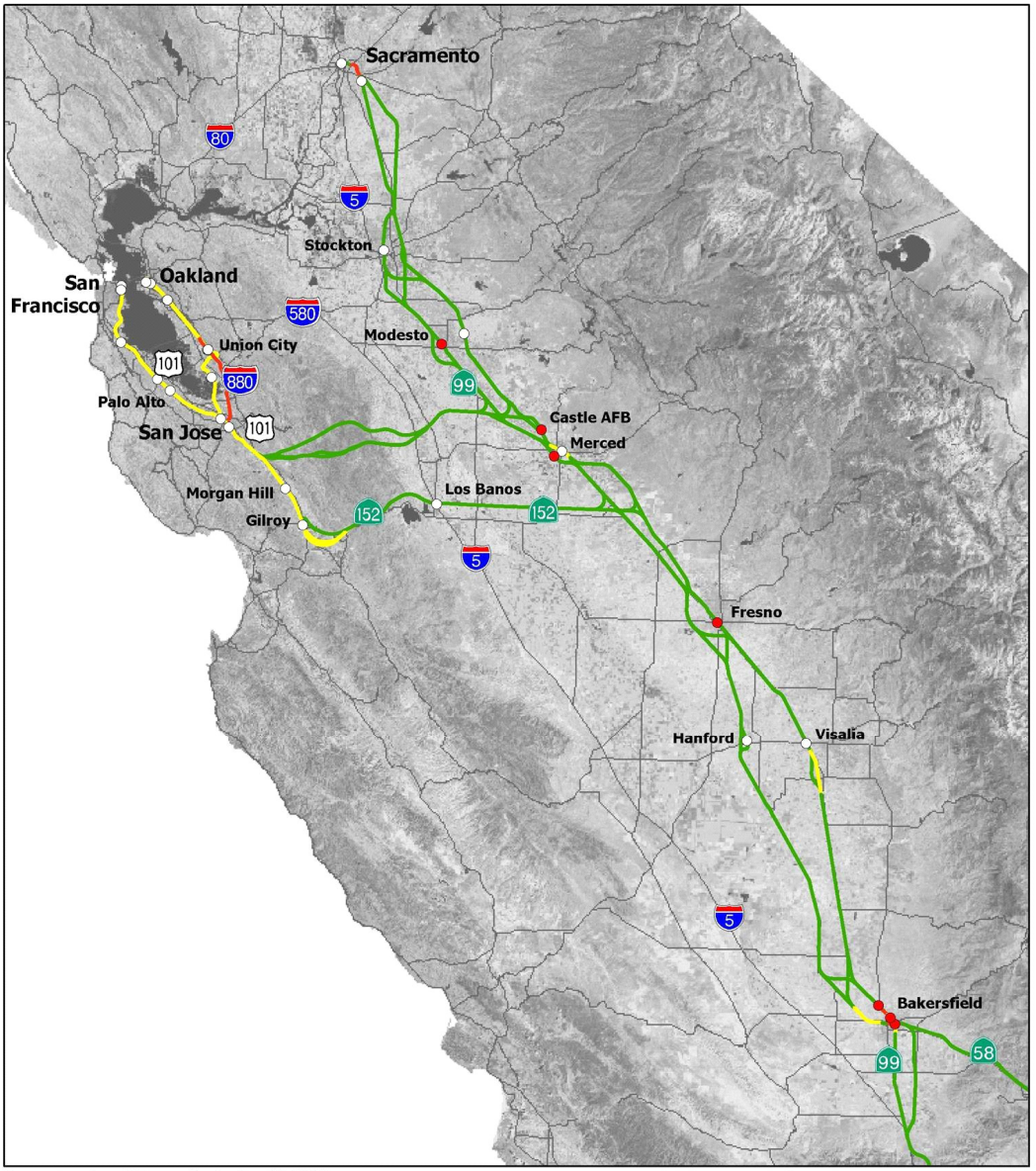
5 0 5 10 15 20 Miles

5 0 5 10 15 20 Kilometers

CALIFORNIA HIGH SPEED RAIL AUTHORITY

Noise Impacts
Modal Alternative
Southern California

Figure 3.4-12
Potential HST Alternative Noise Impact Levels-Northern California



Source: Landsat 1985 September 19, 2003

California High Speed Train Program EIR/EIS

10 5 0 10 20 30 40 Miles

105 0 10 20 30 40 Kilometers

CALIFORNIA HIGH SPEED RAIL AUTHORITY

Legend

Potential Noise Impact Levels

- High
- High (in Urban Areas)
- Medium
- Low
- Potential Station Locations

Potential Noise Impact Levels
Accounting for Grade Crossing Elimination
High Speed Rail Alternative Northern California

Figure 3.4-13
Potential HST Alternative Noise Impact Levels-Southern California

Source: Landsat 1985 September 19, 2003

California High Speed Train Program EIR/EIS

5 0 5 10 15 20 Miles

5 0 5 10 15 20 Kilometers

CALIFORNIA HIGH SPEED RAIL AUTHORITY

Legend

Potential Noise Impact Levels

- High
- Medium
- Low
- Potential Station Locations

Potential Noise Impact Levels
Accounting for Grade Crossing Elimination
High Speed Rail Alternative Southern California

Table 3.4-1
Summary of Noise Impact Ratings for Alternatives

Length (miles) with Potential Noise Impact Ratings[a]									
	Modal[b]			HST (GPI)			HST (LPI)		
REGION	H	M	L	H	M	L	H	M	L
System-wide totals[c]	210	258	1040	107	181	484	21	111	601
System-wide percentage of total[c]	*14*	*17*	*69*	*14*	*23*	*63*	*3*	*15*	*82*
Bay Area to Merced	93	153	131	26	103	70	0	50	103
Sacramento to Bakersfield	26	63	611	11	23	258	5	3	284
Bakersfield to Los Angeles	23	0	199	13	10	88	6	17	114
Los Angeles to San Diego via Inland	68	42	100	57	45	68	10	41	100
LOSSAN	61	43	14	42	65	50	5	65	50

[a] See Appendix 3.4-B for rating method.
[b] Assumed with maintenance or replacement of existing highway noise mitigation.
[c] Totals without LOSSAN.

The potential for direct effects of train noise on wildlife in natural areas is not well documented. Current research suggests that the noise effects of trains traveling at very high-speed could have limited influence on some species close to the tracks. Some research has been performed regarding the reactions of animals to low-flying aircraft, but the specific levels of significance and specific effects related to high-speed trains are not known. Long-term changes in behavior tend to be strongly influenced by factors other than intermittent noise exposure (as would occur with high-speed trains), such as weather, predation, disease and other disturbances to animal populations. Conclusions from research conducted to date provide only preliminary indications of the appropriate noise descriptor, rough estimates of threshold levels for observed animal disturbance, and habituation characteristics of only a few species. Long-term effects continue to be a matter of speculation. Since high-speed trains always will be on the same track and on a schedule, habituation may be likely to occur. Sound levels from train passes are also not as high, nor are onset rates as great as they are from low altitude military aircraft, hence, the observed effects of aircraft may not apply to high-speed trains.

3.4.4 Comparison of Alternatives by Region

A. BAY AREA TO MERCED

Modal Alternative

Under the Modal Alternative, the noise impact ratings for the various highway segments range from high in the urbanized areas to low in the rural areas. Two areas of high impact are the I-880 corridor from I-238 to Fremont/Newark in the East Bay and the US-101 corridor from SFO to Gilroy going south from the Peninsula. In both locations the highway and freeway corridors are adjacent to residential areas. The corridors from San Francisco over the bridge to I-880 and

south to SFO have medium noise impact ratings because of less sensitive land uses adjacent to the freeways in those areas. The part of the region from Gilroy to Merced has low population density, which results in a low potential noise impact rating. Noise impacts on wilderness areas would also be relatively low since the highway improvements identified are expansions of existing facilities (noise corridors).

Increases in railroad operations are another potential source of noise impacts for the Modal Alternative. Potential noise impacts in residential areas are caused by increased train operations and by horns and bells at grade crossings. Commuter rail operations by Caltrain on the Peninsula and, to a lesser extent, Amtrak and freight operations on East Bay are major contributors. However, the change in projected commuter/intercity rail operations between Modal and No Project Alternatives is anticipated to be relatively small compared to the significant increases in highway traffic that will have a greater effect on noise.

The Modal Alternative included a new runway for both Oakland and San Jose airports to accommodate intercity traffic in lieu of HST. Adding runways in a dense urban environment would affect large additional areas due to the size of the physical improvement as well as the increased noise level associated with the improvement. In San Jose, an additional runway would impact a large area of residential and commercial land uses. In Oakland, the increased number of operations would impact the noise levels in surrounding areas. Overall, the Modal Alternative would have a greater number of miles with a high impact rating than the HST Alternative, although the total number of people newly impacted would not be as great in this region, primarily due to prior exposure from the existing highway, rail and air noise components.

High-Speed Train Alternative

The existing Caltrain alignment along the San Francisco Peninsula and the East Bay railroad alignments pass through densely populated communities where there is high potential for noise impacts. The potential noise impacts of the proposed HST service through these areas would result primarily from the greater frequency of trains, since the HST service would be operating at reduced speeds and would create similar noise levels to the existing services. The HST system would be expected to result in the elimination of up to 48 grade crossings on the Peninsula and up to 38 grade crossings on the East Bay. Grade separation of existing rail services would result in considerable benefits from the elimination of the warning bells at existing at-grade crossings and the horn blowing of the existing commuter/intercity services along these alignments. Although the HST service would be going through densely populated communities, the Caltrain alignment and the Hayward/Niles/Mulford Line in the East Bay were rated as having a medium level of potential noise impacts because the HST would be traveling at reduced speeds, and the communities would benefit from grade separation improvements for existing services and electrification of the railroad.

Between San Jose and Gilroy, the HST is rated as having medium potential for noise impacts. While the HST system could reach speeds as great as 186 mph (299 kph) through this area, the densities are less than on the Peninsula or the East Bay, and the communities would receive considerable benefit from the elimination of up to 24 grade crossings.

All the options for mountain crossings between the Bay Area and the Central Valley are through sparsely populated areas, but would introduce new noise sources along corridors through wilderness areas where the alignment is at grade or elevated.

High-Speed Train Alignment Option Comparison

Of the two options in the East Bay, the Hayward/I-880 alignment was given a higher ranking for potential impacts than the Hayward/Niles/Mulford Line, since the former would be elevated and would add noise from the already grade-separated freeway corridor. However, the Mulford Line

would pass through the Don Edwards Wildlife Refuge and would have more impacts on wildlife than the I-880 freeway option.

Between San Jose and Merced, the Pacheco Pass alignments have higher potential for community impacts than the Diablo Range direct crossing options because of the potential for noise impacts through the urban and suburban areas of south Santa Clara County. For the Pacheco Pass alignment options, the Morgan Hill/Caltrain/Pacheco Pass option would minimize potential noise impacts on Gilroy. The Diablo Range direct alignment through Henry Coe State Park at grade would have more potential impacts on wildlife than the other two Diablo Range options because these options would have about 5 mi (8 km) of additional at-grade track rather than tunnel in the wilderness area.

Serving both the Peninsula and the East Bay would increase the number of alignment miles for Bay Area noise impacts, but reduce the frequency of HST service to either side of the bay.

B. SACRAMENTO TO BAKERSFIELD

Modal Alternative

From Sacramento to Bakersfield the potential noise impacts would be generally low. One area of potentially high impact is the I-5 corridor from the middle of Stockton to I-5 due to the close proximity of residential land along this alignment segment. Two segments with a medium rating are along SR-99 south from Sacramento to Manteca and also south from Bakersfield to I-5. Overall, the Modal Alternative has a greater distance with a high impact rating than the proposed HST Alternative, although the total number of people newly impacted is not as great as other regions, primarily due to existing exposure to highway noise. These highway corridors are heavily used by truck traffic, which generates high noise levels through the evening hours.

Potential improvements at the Sacramento Airport and Fresno Airport would not be extensive in terms of additional land area required (additional runways) and would have low potential noise impacts.

High-Speed Train Alternative

Through the Central Valley most of the alignment options for the HST Alternative are rated as low potential noise impact, due generally to the sparseness of residential land use and the extent of open space along most of the length of the options—even though the proposed HST service would be operating at maximum speeds throughout most of the Central Valley. However, there are a number of locations throughout the San Joaquin Valley where the various alignment options pass through populated areas and have high potential noise impact ratings for short segments. Examples include portions of Sacramento, Fresno, Tulare, and Manteca that could be exposed to high noise levels from HST operations.

Through many of the cities in the Central Valley, the HST is proposed to be on aerial structure, primarily to reduce potential conflicts with freight railroad spur tracks or freight railroad yards. The vertical elevation of the aerial structure would allow potential noise impacts to extend further than they would at grade.

Through several of the urban areas, the HST mainline (express or high-speed) alignment could pass through the city or community or avoid it by passing through surrounding areas (primarily farmlands). A representative typology study of the proposed high-speed loop around Fresno concluded there would only be a 12% to 16% reduction in noise impacts by moving the high-speed mainline (express) tracks outside the urbanized areas. The relatively modest decrease in noise impacts is attributed to three factors: 1) there would be some residential impacts along the new express loop; 2) many of the land uses surrounding the freight line through downtown

Fresno are industrial; 3) the express loop results in noise impacts on two corridors as opposed to one. Figure 3.4-14 shows the mainline alignment through Fresno and the express loop options together with the surrounding land uses.

All alignment options in this region would have a low potential vibration impact rating. A few short segments of populated areas would have medium potential vibration impact ratings.

HST Alignment Option Comparison

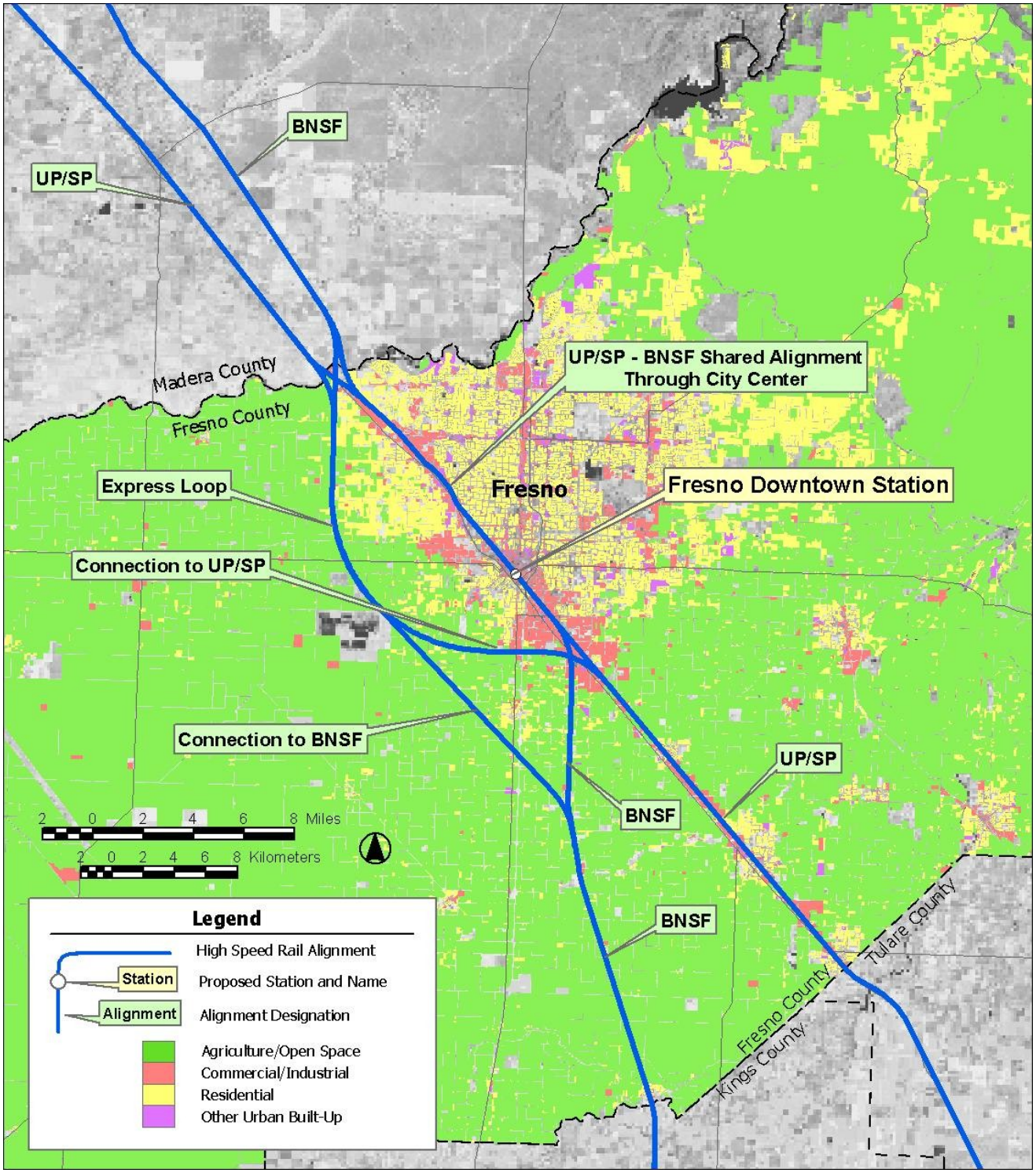
Between Sacramento and Bakersfield there are two potential alignment options for the proposed HST Alternative along railroad rights-of-way, UPRR and BNSF, along with some combinations. The UPRR alignment would have a considerably greater potential for noise impacts than the BNSF alignment. The UPRR alignment passes through much more urban area. The UPRR has more freight activity to the Central Valley cities it bisects, which results in more spur lines, service lines, and freight yards in these communities along the freight alignment. The proposed HST line would be grade-separated from these freight railroad facilities, typically on an elevated structure. Therefore, the UPRR passes through more communities, and would require more elevated structures through these communities. The Central California Traction (CCT) alignment option would have fewer potential noise impacts than the UPRR alignment between Sacramento and Stockton because there are fewer residential areas near the alignment. South of Power Inn Road in Sacramento, both CCT and UPRR would be predominately at grade. Along the UPRR, some grade-separation benefits would result from reducing noise from the existing freight services, whereas the CCT is a recently abandoned freight corridor.

Between Stockton and Merced, the UPRR alignment would have much higher potential noise impacts than the BNSF alignment. UPRR goes through much more urban area as it passes through the cities and communities that developed around the railroad line, and is proposed to be on aerial structure through many of these communities. Conceptually, the alignment options along UPRR would have a substantial amount of aerial structure through Manteca, Modesto, Keyes, Turlock, and Atwater, whereas the alignment through Salida, Ceres, Delhi, Livingston, and Merced would be at grade. The alignment options along BNSF would have a substantial amount of aerial structure through Escalon and Riverbank. Through Riverbank, however, the downtown and most of the populated area would be at grade. BNSF would be at grade through the outskirts of Modesto (Briggsmore), Hughson, Denair, Winton, Atwater, and Merced. Much of the potential noise impact of BNSF may be offset by the noise benefits from grade separating the adjacent freight service when operating at grade.

Between Merced and Fresno, the UPRR alignment option would have higher potential noise impacts than the BNSF alignment. UPRR goes through more urban areas, and is proposed to be on aerial structure through these communities. Conceptually, the alignment options along the UPRR corridor have a substantial amount of aerial structure through both Chowchilla and Madera. The BNSF corridor does not go through much developed area between Merced and Fresno. The BNSF alignment options would be at grade through Le Grand and the outskirts of Madera. Much of the potential noise impact of BNSF may be offset by the noise benefits from grade separating the adjacent freight service when operating at grade. Through Fresno, only the UPRR alignment option is being considered for further evaluation. A majority of the UPRR alignment through Fresno is expected to be at grade.

Between Fresno and Bakersfield, the UPRR alignment option would have much higher potential noise impacts than the BNSF alignment option. However, BNSF would have more potential noise impacts through Bakersfield. UPRR goes through many more urban areas and is proposed to be on aerial structure through many of these communities. Conceptually the alignment options along the UPRR corridor would have a substantial amount of aerial structure through Selma, Traver, Goshen, Tulare, Pixley, and Delano, whereas the alignment through Fowler, Kingsburg

Figure 3.4-14
Mainline and Express Loop at Fresno



(on aerial structure south of the Kingsburg urban area), Tipton, Earlimart, and McFarland would be at grade. The alignment options along the BNSF corridor would have a substantial amount of aerial structure through the outskirts of Corcoran, through Hanford, and Shafter, whereas the BNSF would be at grade through Laton. Through Bakersfield, a majority of the UPRR alignment option is at grade and travels through industrial land uses. The BNSF alignment option would include more aerial structure through Bakersfield and impact more residential areas than the UPRR alignment option.

Through Modesto, Merced, Fresno, and Tulare, the high-speed train mainline (express or high-speed) alignment could pass through the city or community or avoid it by passing through surrounding areas (primarily farmlands). As previously noted, the focused study on the high-speed loop around Fresno concluded there would only be a modest (12% to 16%) reduction in noise impacts by moving the high-speed mainline (express) tracks outside the urbanized areas. The Fresno typology is representative of the express loop bypass design options for other Central Valley communities, and it is expected that the express loop design options for Modesto, Merced, and Tulare would yield similar results to the Fresno typology.

C. BAKERSFIELD TO LOS ANGELES

Modal Alternative

From Bakersfield to Los Angeles there would be more potential noise impacts in the urban areas such as Bakersfield and Los Angeles than in the rural areas. As the highway alternative crosses the sparsely populated Tehachapi Mountains potential noise impacts on residents would be minimal; however, there may be noise impacts on sensitive wildlife.

The expansion of the Burbank airport and the associated higher frequency of take offs and landings would have potential noise impacts in the area surrounding the airport. The addition of a runway would impact a large area of residential and commercial land uses and the increased number of operations would impact the noise levels in surrounding areas. Overall, the Modal Alternative's potential noise impacts would be expected to be greater than potential noise impacts from the HST Alternative. Because the highway would be expanded by as much as 6 lanes through the mountain passes and would not use tunneling, it would have substantial noise impacts on wildlife, recreational use of nature trails, and other outdoor recreation activities and uses.

High-Speed Train Alternative

The proposed HST Alternative would have low potential noise impact ratings between Bakersfield and Sylmar due to the sparseness of residential land use and the extent of open space along most of the two routes. Within Bakersfield, where HST express services would achieve maximum speeds, the two alignment options would pass through areas with residential population and have greater potential noise impacts. As the alignments near Los Angeles, the potential for noise impact increases as the population density increases. The alignment segment between Sylmar and Burbank would be expected to reach relatively high speeds as great as 186 mph (299 kph) and has a high potential for impact through Sylmar and a medium potential for impact through Burbank. Elimination of nine grade crossings between Sylmar and Los Angeles would result in noise reduction benefits to people who live near those crossings. South of Glendale, the proposed HST system would operate at reduced speeds. Most of the segment between Sylmar and Los Angeles is considered to have medium potential noise impacts because of the relatively long trench section proposed and the reduction in noise associated with the removal of grade separations over a long portion of this segment.

High-Speed Train Alignment Option Comparison

The HST Alternative has low potential noise impact ratings along both the I-5 and SR-58/Soledad Canyon alignment options due to the sparseness of residential land use and open space along most of these two routes. However, more of the SR-58/Soledad Canyon alignment option passes through populated areas. In addition, the I-5 alignment would require more tunneling through the open space and natural areas, which would result in fewer potential noise impacts on wildlife, hiking trails, and other outdoor recreational uses.

D. LOS ANGELES TO SAN DIEGO VIA INLAND EMPIRE

Modal Alternative

Between Los Angeles and San Diego along the inland routes, freeway traffic is extremely heavy throughout the area. The high population density in close proximity to the freeways between Los Angeles and San Bernardino/Riverside results in high noise impact ratings for that area. South of March Air Reserve Base (ARB) to Mira Mesa, the lower population density along the highway segments is reflected in a low noise impact rating. Potential noise impacts are rated as medium in the stretch from Mira Mesa to San Diego.

The expansion of the Ontario and San Diego airports and the associated higher frequency of takeoffs and landings would have high potential impacts on the noise levels in the areas surrounding the airports. An additional runway at each of these airports would impact large areas of residential and commercial land uses and the increased number of operations will impact the noise levels in surrounding areas. Overall, the number of potential noise impacts associated with the Modal Alternative falls between the HST GPI and with the LPI in this region.

High-Speed Train Alternative

The high population density in Los Angeles and San Bernardino/Riverside results in both medium and high noise impact ratings for the proposed HST Alternative throughout that area. However, compared to the freeway alignments, the rail alignments generally abut less sensitive industrial and commercial land uses that are less vulnerable to noise. There are also considerable stretches of grade-separation improvements that would reduce impacts from existing freight rail services along portions of the alignment. Between Pomona and Riverside, the UPRR Colton alignment is very straight and contains mostly industrial land uses where the HST system would be expected to achieve maximum speeds for this segment. South of March ARB to Mira Mesa, the lower population density along the I-215 and I-15 highway alignments is reflected in a low noise impact rating. South of Escondido, the HST service would largely be reduced to speeds of 125 mph (201 kph) or less because of alignment issues. Potential noise impacts are rated as medium and high in the stretch from Mira Mesa to downtown San Diego via either Miramar Road or Carol Canyon. All alignment options in this region have potential vibration impact ratings of medium or low.

High-Speed Train Alignment Option Comparison

The HST Alternative alignment option along the UPRR Colton Line (northern alignment option) alignment between Los Angeles and East San Gabriel Valley would have a high potential for noise impacts due to the proximity of residential land use along most of this route, whereas the UPRR Riverside/UPRR Colton alignment is largely surrounded by industrial land uses and is ranked as having a medium potential for noise impacts.

The alignment that would most directly serve San Bernardino would have considerably higher potential noise impacts than the UPRR Colton alignment because it would impact more residential areas. Between Ontario Airport and Colton, the UPRR Colton alignment is within a wide, sparsely developed industrial corridor.

From Los Angeles to March ARB, the low potential vibration rating would be along the UPRR Colton Line option, as compared to a medium rating along the UPRR Colton Line to San Bernardino, due to the lower population within the screening distance along the former alignment.

The Miramar Road alignment option from Mira Mesa to San Diego would have a higher potential noise impact rating than the Carol Canyon alignment option, which would traverse less populated areas. Both the Miramar Road and Carol Canyon alignments would have considerably higher potential noise impacts than the option along I-15 to Qualcomm Stadium. The Qualcomm Stadium option would also have a lower potential for vibration impacts.

E. LOS ANGELES TO SAN DIEGO VIA ORANGE COUNTY

Modal Alternative

Under the Modal Alternative, the potential for high noise impacts would occur along the I-5 corridor from downtown Los Angeles to Irvine and also in San Juan Capistrano, Encinitas, and San Diego. These potential noise impacts would be due primarily to the close proximity of residential land along these alignment segments. The coastal area south of Dana Point up to Encinitas would not be as highly impacted due to the relatively open agricultural areas along the freeways. The Modal Alternative would have generally greater impact than the proposed HST options through this region. South of Encinitas along the coastal areas to San Diego and across lagoons with sensitive habitat and numerous birds, the noise impacts of expanded highways would be added to existing noise levels.

High-Speed Train Alternative

The HST Alternative would be expected to have potential impacts that are high along the LAX connection alignment for the proposed HST and the UPRR Santa Ana alignment from Los Angeles to Anaheim. Although the proposed HST speeds along the LAX alignment would be well under 100 mph (161 kph), a new, frequent, passenger service would be introduced into a dense urban area, resulting in a new and significant noise source.

Overall, the LOSSAN alignment would receive benefits from grade crossing eliminations that would be part of the proposed improvements. A major benefit is the elimination of horn noise at the grade crossings. Horn noise dominates the area within 0.25 mi (0.40 km) of a grade crossing, such that its elimination would more than make up for the increased train noise. It is estimated that potential noise impacts can be reduced by approximately 80% at adjacent receptors by eliminating freight and passenger train horns, according to the noise study results.

High-Speed Train Alignment Option Comparison

The LOSSAN rail alignment between Los Angeles and Anaheim has a considerably lower noise impact rating than the UPRR Santa Ana alignment. The communities along the LOSSAN alignment would receive benefits from full grade separation due to the elimination of warning bells and train horn noise from existing services (Amtrak, Metrolink, and freight) along this heavily used rail line. In contrast, UPRR Santa Ana would be introducing a new, frequent, passenger service to a lightly used freight alignment.

Between Anaheim and Irvine, both the HST alignment option (to bring direct service to Irvine), and the high end conventional rail improvements option would result in a fully grade-separated LOSSAN rail alignment. The communities along the LOSSAN alignment (Orange, Santa Ana, and Tustin) would receive benefits from full grade separation due to the elimination of warning bells and train horn noise from existing services (Amtrak, Metrolink, and freight) along this heavily used rail line from these options. In contrast, the low end conventional rail improvements would

permit additional frequencies of service, which would have additional noise impacts without the benefits of grade separation.

3.4.5 Design Practices

Because of the high-speed alignment requirements of the HST system, over nearly 10% of the preferred alignments are in a tunnel or trench section. For these segments of the system the potential for noise impacts are mostly eliminated. The tunnel cross sections are designed (per established engineering criteria) to provide sufficient cross sectional area to avoid potential aerodynamic effects at the tunnel portals due to trains operating at maximum speed.

At similar speeds high-speed trains generate significantly less noise than existing commuter and freight trains. This is primarily due to the use of electric power versus diesel engines, higher quality track interface, and smaller, lighter and more aerodynamic trainsets. The use of electric power units would not have the engine rumble associated with diesel-powered locomotives. While wheel/track interface is a significant source of train noise, HST track beds and rails are designed and maintained to very high geometric tolerances and standards which would greatly minimize track noise that is prevalent with existing commuter/freight tracks throughout the study area.

Another reason HST noise impacts are less than commuter or freight trains is that high speeds would result in short duration noise events compared with conventional trains (a few seconds at the highest speeds versus 10 to 20 seconds for conventional passenger trains and well over 1 minute for freight trains).

The HST system would be fully grade separated from all roadways. In the urban areas where potential for noise impacts is typically at the highest levels, the HST system is predominantly in or adjacent to existing rail corridors and the HST Alternative often includes the grade separation of the existing tracks. Grade separations completed with the HST system in corridors such as these would eliminate current horn sounding and bells at existing grade crossings and would result in a noise benefits that would offset much of the HST noise impacts.

3.4.6 CEQA Significance Conclusions and Mitigation Strategies

Based on the analysis above, and considering the CEQA Appendix G thresholds of significance for noise and the FRA guidance manual discussed in section 3.4.1, the HST alternative would have a potentially significant impact on noise when viewed on a system-wide basis. The HST alternative would create construction-related short-term noise impacts. The HST alternative would also create long-term noise impacts from introduction of a new transportation system, including potential vibration impacts. At the same time, the HST alternative would create some long-term noise reduction benefits due to elimination of noise sources with grade separation of existing grade crossings. While the significance of the impacts is dependent on the sensitivity of the landscape and noise receptors, the analysis finds some high impacts on noise-sensitive land uses and populations and these impacts are therefore considered significant. Mitigation strategies, as well as the design practices discussed in section 3.4.5, will be applied to reduce this impact.

General mitigation strategies are discussed in this programmatic review of potential noise impacts associated with proposed alternatives. More detailed mitigation strategies for potential noise and vibration impacts would be developed in the next stage of environmental analysis. Noise and vibration mitigation measures can generally be applied to the source (train and associated structures), the path (area between train and receiver) and/or the receiver (property or building). A new HST system would be designed and developed to meet state-of-the-art technology specifications for noise and vibration, based on the desire to provide the highest-quality train service possible. Trains and tracks would be maintained in accordance with all applicable standards to provide reliable operations.

Treatments such as sound insulation or vibration controls to impacted buildings may be difficult to implement for the potentially numerous properties adjacent to the right-of-way. Such treatments require protracted implementation procedures and separate design considerations. The most feasible and effective mitigation treatments are typically those involving the path. These mitigation measures can often be applied to the path within the right-of-way, either under or adjacent to the tracks. Potential noise impacts can be reduced substantially by the installation of sound barrier walls constructed to shield receivers from train noise. For vibration mitigation, a number of track treatments may be considered for reducing train vibrations. Determining the most appropriate treatment would depend on the site-specific ground conditions found along the corridor. This program-level analysis has identified areas where future analysis should be given to potential HST-induced vibrations.

A. NOISE BARRIERS

Noise barriers are often a practical way to reduce noise impacts from transportation projects including the proposed HST system. The representative typologies considered mitigation with noise barriers for certain areas. In most cases the potential noise impacts could be reduced from the severe impact category to the FRA's impact category, and to the no impact category in some locations, with the application of appropriately dimensioned noise barriers next to the tracks. The design of noise barriers appropriate for the proposed HST right-of-way line would depend on the location and height of noise-sensitive buildings, as well as the speeds of the trains. Noise barriers 8 to 10 ft (2 to 3 m) tall could be installed where speeds are relatively low such that wheel/rail noise dominates. Higher noise barriers of 12 to 16 ft (4 to 5 m) might be used to reduce noise to taller buildings, or where speeds are high in noise-sensitive areas. In many locations noise barriers could be installed on one side of the track only, due to he location and proximity of noise-sensitive areas.

Application of mitigation to the proposed HST system would result in a considerable reduction of potential noise impacts. The estimates obtained from the results of the representative typologies showed noise barriers to be effective in reducing the potential noise impact rating by one category, for example, from high to medium or from medium to low. Consequently, HST segments with high rating would be adjusted down to, at most, a medium rating. With mitigation applied to the HST Alternative, both the GPI and LPI scenarios would represent substantially lower levels of potential impacts as compared to the Modal Alternative.

To estimate the reduction in noise impacts, the percentage reduction in noise for each segment was applied to the total number of people impacted in that segment, assuming the mitigation removed that many people from being impacted. The number of people remaining in the impact category was then summed for each region and system-wide. The lengths of the routes requiring noise barriers were then tabulated to provide an estimate of the mitigation costs.

The cost of constructing a noise barrier on one side of a highway or a rail line is estimated at approximately $1 million per mi ($625,000 per km) for a concrete wall of 12 ft (4 m) in height. Conservatively, a unit cost of $1.5 million per mi ($937,500 per km) was applied to the alignment segments in the HST Alternative with high potential noise impact ratings. The procedure was repeated for all segments with a medium rating in addition to those with high rating, thereby reducing all HST noise impact ratings to low. The same costs were applied to the Modal Alternative for comparison using segment lengths with a high noise impact rating. This approach was intended to provide a rough estimate of potential mitigation costs, recognizing that specific mitigation would be developed as a part of project-level review.

The results in Table 3.4-2 show that potential mitigation costs for the HST Alternative, applied to the segments rated at high potential for noise impacts only, would be less than the costs of similar mitigation applied to the Modal Alternative. This analysis included noise mitigation (barrier walls) for 8 of the 731 route miles (13 of the 1,176 route km) of the proposed HST segments with LPI and 133

of the 773 route miles (214 of the 1,244 route km) with GPI. With mitigation applied to both high- and medium-rated segments, the HST potential impacts would be reduced further below the Modal Alternative, including noise mitigation (barrier walls) for 144 and 369 route miles (232 and 594 route km), for the LPI and GPI, respectively.

Table 3.4-2
Potential Length and Cost of Noise Mitigation[a] by Alternative

Alternative	Mitigation length in miles (km)	Noise Barrier Cost (millions)
MODAL—highway component (high level only)	210 (338)	$315
HST mitigating (high levels only)	8–133 (13–214)	$12–$200[b]
HST mitigating (high and medium levels)	144–369[b] (232–594)	$216–$554[b]

[a] Mitigation refers to barrier walls only.
[b] Range for LPI and GPI.

Not included in the costs for the Modal Alternative are noise abatement measures at airports that may involve extensive programs of sound insulation of homes. A typical sound insulation program limits the costs to approximately $30,000 per home. Referring to tables in Appendix 3.4-D where the number of people impacted by aviation noise is shown as approximately 12,000 people, and assuming there are four people to a house, the cost for noise mitigation around airports associated with the Modal Alternative could be an additional $90 million.

B. VIBRATION MITIGATION

Vibration mitigation is less predictable at a program level of analysis due to the site-specific nature of vibration transmission through soil conditions along the alignment. However, an estimate can be made of the length of corridor where special mitigation may need to be considered by totaling the segments with potential vibration impact rating of high. The results are shown in Appendix 3.4-E. The range is 10 to 60 mi (16 to 97 km) to be considered for mitigation depending on which alignment is chosen.

C. CONSTRUCTION MITIGATION

Potential mitigation strategies for construction noise impacts associated with the HST Alternative are listed below.

- Construction noise could be reduced by using enclosures or walls to surround noisy equipment, installing mufflers on engines, substituting quieter equipment or construction methods, minimizing time of operation and locating equipment farther from sensitive receptors.
- Construction operations could be suspended between 7:00 p.m. and 7:00 a.m. or on weekends or holidays in residential areas.
- Contractors could be required to comply with all local sound control and noise level rules, regulations and ordinances.
- Ensure that each internal combustion engine would be equipped with a muffler of a type recommended by the manufacturer.
- Other measures that should be considered include the following:
- Specifying the quietest equipment available would reduce noise by 5 to 10 dBA.
- Turning off construction equipment during prolonged periods of non-use would eliminate noise from construction equipment during those periods.

- Requiring contractors to maintain all equipment and train their equipment operators would reduce noise levels and increase efficiency of operation.
- Locating stationary equipment away from noise sensitive receptors would decrease noise impact from that equipment in proportion to the increased distance.

The above mitigation strategies are expected to reduce the short-term and long-term noise impacts of the HST alternative to a less-than-significant level. Additional environmental assessment will allow a more precise evaluation in the second-tier project-level environmental analyses.

3.4.7 Subsequent Analysis

A. NOISE ANALYSIS

The FRA provides guidance for two levels of analysis in project environmental review, a general assessment method to further quantify the potential noise impacts in locations identified by the screening procedure, and a detailed analysis procedure for evaluating suggested noise mitigation at locations where further studies show there is potential for significant impacts. The process is designed to focus on problem areas as more detail becomes available during project development. Subsequent analysis would proceed along the following lines.

Ambient noise conditions
The existing ambient noise environment is described by assumptions in the screening procedure. However ambient noise values would be estimated at the project-level analysis based on limited measurements in the general assessment and would be thoroughly measured in the detailed analysis. A measurement program involving both long-term and short-term noise monitoring would be performed at selected locations to document the existing noise environment. As it would be impractical to measure everywhere, the monitoring would be supplemented by estimates of noise environments at locations considered to be typical of others. Guidelines for characterizing the existing conditions are provided by the FRA.

Project Noise Conditions
A generic HST is used in the screening procedure, but a specified train type, speed profile and operation plan would be available for more refined projections of noise levels in the next stage of environmental analysis.

Noise Propagation Characteristics
The screening procedure assumes flat terrain with noise emanating from a source unhindered by landforms and human-made structures. The next stage of analysis would incorporate topography as well as consideration of shielding by buildings, vegetation, and other natural features in a particular corridor.

Impact Criteria
The screening procedure accounts for all noise-sensitive land use categories that may be exposed to noise levels exceeding the threshold of impact. In the next stage of analysis, assessments using the full, three-level FRA impact criteria would be performed (U.S. Department of Transportation 1998). This more detailed assessment would more specifically identify locations where potential impacts may occur and locations where potentially high impact may occur and would provide for consideration of specific mitigation measures where appropriate.

Mitigation
Noise abatement is discussed generally in the screening procedure, and areas are identified where more detailed analysis should be focused in the future to integrate a proposed HST system into the existing environment. As more detail becomes available in the general assessment

phase, there may be many areas that were identified as potentially impacted during screening analysis for which further analysis would not be needed, because they would not be impacted. The detailed analysis would provide information useful for the engineering design of mitigation measures. These measures would be considered in the project-level environmental review, and potential visual and shadow impacts of noise barriers would also be considered.

B. VIBRATION ANALYSIS

The steps involved in the more detailed analysis of ground-borne vibration would be similar to those for noise. The major difference would be the need for study of site-specific ground-borne vibration characteristics. Considerable variation of soil conditions may occur along the corridor, resulting in some locations with significant levels of vibration from the HST and other locations at the same distance from the track where vibrations can hardly be perceived. Determining the potential vibration characteristics in the detailed analysis would involve a measurement program performed according to the method described in the FRA guidance manual (U.S. Department of Transportation 1998). This method would allow for the prediction of vibration levels and frequency spectrum information valuable not only in the assessment of impact, but also in the consideration of mitigation measures.

3.5 ENERGY

This analysis provides an overview of the potential operation and construction impacts associated with both the general overall use of energy and the more specific use of electrical energy for the existing conditions and the No Project, Modal, and High-Speed Train (HST) Alternatives.

3.5.1 Regulatory Requirements and Methods of Evaluation

A. REGULATORY REQUIREMENTS

Federal Regulations

Federal Energy Regulatory Commission: The Federal Energy Regulatory Commission (FERC) is an independent agency that regulates the interstate transmission of natural gas, oil, and electricity. FERC also regulates natural gas and hydropower projects. As part of that responsibility, FERC regulates the transmission and sale of natural gas for resale in interstate commerce, the transmission of oil by pipeline in interstate commerce, and the transmission and wholesale sales of electricity in interstate commerce. FERC also licenses and inspects private, municipal, and state hydroelectric projects; approves the siting of and abandonment of interstate natural gas facilities, including pipelines, storage, and liquefied natural gas; oversees environmental matters related to natural gas and hydroelectricity projects and major electricity policy initiatives; and administers accounting and financial reporting regulations and conduct of regulated companies.

Corporate Average Fuel Economy Standards: Corporate Average Fuel Economy (CAFE) standards are federal regulations that are set to reduce energy consumed by on-road motor vehicles. The standards specify minimum fuel consumption efficiency standards for new automobiles sold in the United States. The current standard for passenger cars is 27.5 miles per gallon (mpg) (44.3 kilometers per gallon [kpg]). The 1998 standard for light trucks was 20.7 mpg (33.3 kpg) (Competitive Enterprise Institute 1996). In April 2002, the National Highway Traffic Safety Administration, part of the U.S. Department of Transportation (DOT), issued a final rule for CAFE standards for model-year 2004 light trucks that codified a standard of 20.7 mpg (33.3 kpg); this level is now in effect (U.S. Department of Transportation 2002a).

Transportation Equity Act for the 21st Century: The Transportation Equity Act for the 21st Century (TEA21), passed in 1998, builds on the initiatives established in the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), which was the prior authorizing legislation for surface transportation. The ISTEA identified planning factors for use by Metropolitan Planning Organizations (MPOs) in developing transportation plans and programs. Under the ISTEA, MPOs are required to "protect and enhance the environment, promote energy conservation, and improve quality of life" and are required to consider the consistency of transportation planning with federal, state, and local energy goals (U.S. Department of Transportation 2002b).

Section 403(b) of the Power Plant and Industrial Fuel Use Act of 1978 (P.L. 95-620): This section of the Power Plant and Industrial Fuel Use Act encourages conservation of petroleum and natural gas by recipients of federal financial assistance.

Executive Order 12185, Conservation of Petroleum and Natural Gas (December 17, 1979, 44 F.R. § 75093): This executive order encourages additional conservation of petroleum and natural gas by recipients of federal financial assistance.

State Regulations

Public Resources Code Section 21100(b)(3) provides that an EIR shall include a statement setting forth the mitigation measures proposed to minimize the significant effects on the environment,

including measures to reduce the wasteful, inefficient, and unnecessary consumption of energy. Appendix F to the California Environmental Quality Act (CEQA) Guidelines addresses energy conservation goals, notes that potentially significant energy implications of a project should be considered in an EIR, and contains general examples of mitigation measures for a project's potentially significant energy impacts.

CEQA Guidelines Section 15126.2 discusses requirements for an EIR to address potentially significant effects, and although it does not include energy specifically, it mentions use of nonrenewable resources. CEQA Guidelines Section 15126.4(a)(1)(C) requires an EIR to discuss energy conservation measures, if relevant.

California Code of Regulations, Title 24, Part 6, Energy Efficiency Standards: Title 24, Part 6 of the California Code of Regulations, Energy Efficiency Standards, promotes efficient energy use in new buildings constructed in California. The standards regulate energy consumed for heating, cooling, ventilation, water heating, and lighting. The standards are enforced through the local building permit process. These standards may apply to any buildings (e.g., stations) constructed as part of or in association with the No Project, Modal, and HST Alternatives.

B. METHOD OF EVALUATION OF IMPACTS

This evaluation of energy supply and demand compares potential energy use for intercity travel of the proposed alternatives. This section explains the methodology used to evaluate the potential energy impacts and benefits attributable to operation (direct energy) and construction (indirect energy) of the alternatives under study. This section also explains the criteria used to determine whether a potential impact on energy consumption would be significant. The evaluation is based on available data and forecasts.

Direct Energy

Analyses were performed as described below to determine the operational impact of the alternatives on overall statewide transportation-related energy supply[1] and statewide electricity supply during peak demand.

Overall Statewide Transportation-Related Energy Supply: Overall direct energy consumption by the alternatives involves potential energy use by the operation of vehicles (automobiles, airplanes, and HSTs) and related infrastructure in the state. The potential direct impacts on overall transportation-related energy supply were evaluated both quantitatively and qualitatively.

The quantitative analysis focused on the direct relationship between projected vehicle miles traveled (VMT) and energy consumption to estimate the potential change in total energy consumption between the No Project, Modal, and HST Alternatives. Only intercity trips that would be served by the HST system, including some long-distance commute trips, were considered when modeling VMT. Local commute and other regional and intercity trips were not considered. The quantitative assessment of direct energy impacts considered the following.

- VMT for automobiles, airplanes, and HST within the study area, as described below in Section 3.5.2 (consistent with the analysis conducted for Section 3.3, Air Quality).
- Variation of fuel consumption rates by vehicle type.

Ridership projections for the HST system varied between 42 million and 68 million passengers (including 10 million long-distance commuters) for 2020, with potential for significantly higher

[1] *Overall energy* refers to the combination of energy derived from petroleum fuels and electrical energy.

ridership beyond 2020. The figures on the lower end of these estimates are considered investment-grade forecasts and are based conservatively on year 2000 costs, travel times, and congestion levels of air and automobile transportation. The figures on the higher end are based on a sensitivity analysis, which assumes the increased costs and congestion associated with air and automobile travel would result in greater potential ridership for the proposed intercity HST. The sensitivity analysis assumed investment-grade ridership forecasts and applied variations in mode characteristics that would tend to increase HST ridership and revenue in order to determine how sensitive HST ridership would be to increases in air and automobile rates of travel, air and automobile travel times, and airfares. This sensitivity analysis produced a higher ridership forecast, which is used in this Program EIR/EIS to estimate or project a maximum impact potential for the Modal and HST Alternatives.

For this Program EIR/EIS, the higher demand forecast of 68 million riders (58 million intercity trips and 10 million commute trips), based on the sensitivity analysis, offers a more reasonable estimate to represent total capacity of the proposed HST system, while serving as a representative worst-case scenario for defining the physical and operational aspects of the alternatives in 2020. This higher forecast is generally used as a basis for defining the Modal and HST Alternatives and is referred to in this report as the representative demand. In some specific analyses, such as this energy analysis, the high-end forecasts result in a benefit because the additional HST riders would make the HST more energy efficient (i.e., it would use less energy per passenger), thus creating a higher energy benefit to the overall intercity transportation system than the low-end (investment-grade) forecasts. In cases where the investment-grade forecasts result in greater impact levels than would result with representative demand, additional analysis is included to address the differences in potential energy impacts between what is expected under each of the ridership scenarios.

Projections of HST ridership and the number of trips that would otherwise use other modes were calculated and reported by Charles Rivers Associates in *Independent Ridership and Passenger Revenue Projections for High Speed Rail Alternatives in California* (California High Speed Rail Authority 2000). These projections were the basis for determining projected statewide VMT for each mode. Projections in the ridership report were based on surveys of current intercity air, conventional rail, and private vehicle travelers, historical and forecast population, income, traffic data, and an airline simulation model. HST trip durations and departure frequencies, fares, station locations, and amenities also affected ridership projections.

This energy analysis applies the higher-end forecasts from the Charles River Associates' sensitivity analysis. Automobile VMT modeling for the proposed HST Alternative was developed as part of this Program EIS/EIR and used to develop VMT values for existing conditions and the No Project and Modal Alternatives.

The VMT fuel consumption method used herein is outlined in the *Technical Guidance*, Section 5309 New Starts Criteria (Federal Transit Authority, Office of Planning 1999). Energy consumption factors for the first two modes identified in Table 3.5-1 were developed by Oak Ridge Laboratory and published in the 2002 *Transportation Energy Book* (Edition 22) (Oak Ridge Laboratory 2002). These results are based on national averages for road, traffic, and weather conditions, and are intended for general comparisons. The energy consumption factor for the HST mode is based on energy used by similarly designed trains, such as the Trains à Grande Vitesse in France and the Intercity Express in Germany (DE Consult 2003). This report assumes a 16-car trainset (engines and cars) with a 1,200-passenger carrying capacity.

Table 3.5-1
Direct Energy Consumption Factors

Mode	Factor
Passenger vehicles (auto, van, light truck)[a]	5,669 Btus/VMT
Airplanes[a]	334,086 Btus/VMT
High-speed trains[b]	924,384 Btus/VMT

Btus = British thermal units

Sources:
[a] Oak Ridge Laboratory 2002; based on nationally averaged conditions and fleet composition.
[b] DE Consult 2003, based on a 16-vehicle trainset.

Overall direct energy, measured in British thermal units (Btus), was converted to equivalent barrels of crude oil to represent potential energy impact and/or savings. (Btus are the standard units used by industry and government literature for such comparisons. Metric units for energy [i.e., Joules] are not used in this report.) Annual direct-energy consumption values for intercity travel were calculated for existing conditions and the No Project, Modal, and HST Alternatives, and compared. The potential change in commuter-derived direct energy consumption from the future No Project condition (in Btus) was calculated for the Modal and HST Alternatives.

The qualitative analysis of overall direct energy consumption considers the estimated or assumed levels of service for each of the alternatives and the effect that each would have on congestion and travel speeds, which would have a substantial impact on fuel efficiency and, therefore, energy use.

In addition to the overall direct energy analysis, average energy consumption per passenger mile was calculated for each of the transportation modes essential to the development of the Modal and HST Alternatives.

Statewide Electricity Supply During Period of Peak Demand: For the HST Alternative, peak-period electricity demand was determined using an energy consumption factor for HSTs obtained from DE Consult Peer Review Report (DE Consult 2000) and the operation plan from the California High Speed Rail Authority's (Authority's) final business plan (Business Plan). The demand was calculated in terms of megawatts and compared to current estimates of peak demand and supply capacity within grid controlled by the California Independent State Operator (Cal-ISO). Peak demand for electricity for the future No Project and Modal Alternatives is discussed qualitatively, as it is not possible to measure at the program level. This approach is reasonable because the possible increase in transportation-related electricity use associated with these alternatives would likely be small and considered insignificant.

Indirect Energy

The indirect energy impacts considered here include two potential construction-related energy consumption factors: construction of proposed alternatives and construction of secondary facilities.

Construction of Alternatives: Projected construction-related energy consumption refers to energy used for the construction of HST trackway and support facilities under the HST Alternative and highway expansion and airport runway improvements under the Modal Alternative, and transportation of materials and equipment to and from the work site. Construction-related energy consumption factors for the proposed HST system cannot be compiled because of the relative dearth of available HST examples from which to draw data. Data gathered for typical

heavy rail systems and a heavy rail commuter system, San Francisco Bay Area Rapid Transit District (BART), were used to estimate projected construction-related energy consumption of the proposed HST system. Projected construction-related energy consumption for the Modal and HST Alternatives is presented in Table 3.5-2. These estimates are appropriate for comparison purposes.

The construction energy payback period measures the number of years that would be required to pay back the energy used in construction with operational energy consumption savings. The payback period was calculated for this section by dividing the estimate of each alternative's construction energy by the amount of energy that would later be saved by each of the proposed alternatives compared to the No Project condition. It was assumed that the amount of energy saved in the study year (2020) would remain constant throughout the payback period.

Table 3.5-2
Construction-Related Energy Consumption Factors

Mode	Facility	Rural Compared to Urban[f]	Factor (billions of Btus)
Modal Alternative			
Automobile	Highway (at grade)	Rural[a]	17.07/one-way lane mi
		Urban[b]	26.28/one-way lane mi
	Highway (elevated)	Rural[a]	130.38/one-way lane mi
		Urban[b]	327.31/one-way lane mi
Airplane	Runway	N/A[g]	6,312/runway
	Gate	N/A[g]	78[c]/gate
HST Alternative			
High-Speed Train	At grade	Rural[d]	12.29/one-way guideway mi
		Urban[e]	19.11/one-way guideway mi
	Elevated	Rural[d]	55.46/one-way guideway mi
		Urban[e]	55.63/one-way guideway mi
	Below grade (cut)	Rural[d]	117.07/one-way guideway mi
		Urban[e]	163.14/one-way guideway mi
	Below grade (tunnel)	Rural[d]	117.07/one-way guideway mi
		Urban[e]	328.33/one-way guideway mi
	Station	N/A[g]	78[c]/station

[a] Estimates reflect average roadway construction energy consumption.
[b] Estimates reflect range maximum for roadway construction energy consumption.
[c] Value for construction of freight terminal. Used as proxy for unknown air gate and HST station consumption factors.
[d] Estimates reflect typical rail system construction energy consumption.
[e] Estimates reflect BART system construction energy consumption as surrogate for HST construction through urban area.
[f] Differences between the construction-related energy consumption factors for urban and rural settings reflect differences in construction methods, demolition requirements, utility accommodation, etc.
[g] Discreet (i.e., non-alignment-related facilities) are not differentiated between rural or urban because the data used to develop the respective values were not differentiated as such. Some difference between the actual values might be expected.

Sources: Congressional Budget Office 1977; Congressional Budget Office 1982 Congressional Budget Office in Energy and Transportation Systems, Prepared for the Federal Highway Administration, Sacramento, CA, by California State Department of Transportation (California Department of Transportation 1983); based on construction for air freight services.

Secondary Facilities: A *secondary facility* is a facility that consumes energy in the production of materials related to the project alternatives. For example, a factory that produces construction materials and machinery that would be used in the construction and maintenance of the alternatives' structures and attendant facilities would be a secondary facility. Potential impacts resulting from energy consumption of secondary facilities are discussed qualitatively. Consideration was given to whether nonrenewable resources would be consumed in a wasteful, inefficient, or unnecessary manner, (with special attention given to the efficiency of production of construction materials and machinery and the choices made regarding construction methodology and procedures, including equipment maintenance).

C. CRITERIA FOR DETERMINING SIGNIFICANCE OF IMPACTS

According to Appendix F of the CEQA Guidelines, the means to achieve the goal of conserving energy include 1) decreasing overall per capita energy consumption, 2) decreasing reliance on natural gas and oil, and 3) increasing reliance on renewable energy sources. The significance criteria discussed herein are used to determine whether the alternatives would have a potentially significant effect on energy use, including energy conservation.

The No Project Alternative is the primary basis against which potential impacts of the Modal and HST Alternatives are compared. Significant potential operational energy impacts would occur if the Modal or HST Alternative would result in either substantial demand on statewide and/or regional energy supply, or a significant additional capacity requirement; or significant increase in peak- and base-period electricity demand.

Significant potential construction-related energy impacts would occur if construction of either the Modal or HST Alternative would consume nonrenewable energy resources in a wasteful, inefficient, or unnecessary manner. Implementation of the Modal or HST Alternative would have a significant adverse effect if it, together with regional growth, would contribute to a collectively significant shortage of regional or statewide energy. By contrast, if the implementation of either alternative resulted in energy savings or alleviated demand on energy resources, the alternative would contribute to energy conservation and would have a beneficial effect.

3.5.2 Affected Environment

A. STUDY AREA DEFINED

The areas potentially affected by overall energy use of the alternatives are the regions comprising six of California's 15 air basins. (See Figure 3.3-1 in Section 3.3, *Air Quality*, for a map of the state's 15 air basins.) The following six air basins fall within the study area defined for overall energy use.

- San Francisco Bay Area.
- Sacramento Valley.
- San Joaquin Valley.
- Mojave Desert.
- South Coast.
- San Diego County.

At this program level of analysis, the data needed to model overall energy use are similar to those used to analyze air quality effects, which were also analyzed at the air basin level. (See discussion of air quality in Section 3.3.) The air basins used in this analysis were identified because the majority of intercity trips taken in California occur within them. Nearby air basins could also be affected by the

project alternatives, but any impact would likely be minimal compared to impacts on the basins that physically contain the project alternatives.

At this program level of analysis, the area studied to determine the potential effects of the proposed alternatives on electricity generation and transmission was the entire state of California, since most of this infrastructure in the state contributes to the statewide grid. In general, any potential effects on electrical production which may result from the proposed alternatives would affect statewide electricity reserves and, to a lesser degree, transmission capacity. Some general discussion of potential effects on regional electricity production and transmission is included.

B. GENERAL DISCUSSION OF ENERGY RESOURCES

California is the tenth-largest worldwide energy consumer and is ranked second in consumption in the U.S. behind Texas. Of the overall energy consumed in the state, the transportation sector represents the largest proportion at 46%. The industrial sector follows at 31%, residential at 13%, and commercial at 10%. Petroleum satisfies 54% of California's energy demand, natural gas 33%, and electricity 13%. Coal fuel in California accounts for less than 1% of total energy demand. Electric power and natural gas in California are generally consumed by stationary users, whereas petroleum consumption is generally accounted for by transportation-related energy use (California Energy Commission 2000). A description of the existing energy resources and market conditions that could be potentially affected by the proposed alternatives is provided below.

Petroleum

Demand for transportation services (and, therefore, petroleum/gasoline consumption) in California mirrors the growth of the state's population and economic output. Historical trends coupled with current population and economic growth projections indicate that transportation sector use of gasoline and diesel fuels can be expected to increase by approximately 40% over the next 20 years; gasoline demand is projected to increase from 13.9 billion gallons (gal) (52.6 billion liters [L]) in 1999 to 19.9 billion gal (75.3 billion L) by 2020, and diesel from 2.4 billion gal (9.1 billion L) to 4.8 billion gal (18.2 billion L) over the same period. The California Energy Commission (CEC) projects that in-state oil refining capacity will lag behind this forecasted growth if major changes to the in-state oil refining industry are not made, which could contribute to long-term volatility in the price of both gasoline and diesel fuel (California Energy Commission 2000). Foreign petroleum imports account for approximately 29% of the state's petroleum supply, a percentage that would be expected to increase as in-state and Alaskan oil production declines (California Energy Commission 2002c).

The combination of the strong growth in gasoline demand, recently phased-out fuel additive methyl tertiary butyl ether (MTBE), significantly expanded use of ethanol necessitated by the federal minimum oxygen requirement, and transition to Phase 3 reformulated gasoline (RFG) could negatively affect the balance between supply of and demand for transportation fuels in California and impair the ability of refiners to supply consistent volumes of gasoline to meet California's demand. MTBE is a gasoline-blending component that was used as a gasoline oxygenate to help control carbon monoxide emissions before being phased out of gasoline sold in California (December 31, 2002). Phase 3 RFG prohibits use of MTBE and directs use of only ethanol as an oxygenate. Revisions of state and federal regulations to further tighten specifications for diesel fuel have been adopted to reduce environmental impacts. Together, these efforts to improve the environmental performance of petroleum fuels pose challenges for producing fuel volumes required to satisfy California's growing transportation-related fuel consumption. According to CEC staff, it would be difficult for the state to rely solely on petroleum-based fuels in the future, assuming a stable transportation fuel market is the desired outcome. (California Energy Commission 2000.)

Electricity

Electric energy is given consideration in this analysis because of the projected use of electric energy to power the proposed HST.

Existing State Electricity Supply and Demand: In-state electricity generation, which accounted for 85% of the 2001 total electrical supply, is fueled by natural gas (42.7%); nuclear sources (12.6%); coal[2] (10.4%); large hydroelectric resources (8.0%); petroleum (0.5%); and renewable resources, including wind, solar, and geothermal (10.5%). Electricity imports in 2001 were 15% of total production. Imports from the Pacific Northwest accounted for 2.6%, and 12.8% came from the Southwest. (California Energy Commission 2003.)

According to the CEC, total statewide electricity consumption grew from 166,979 gigawatt-hours (GWh) in 1980 to 228,038 GWh in 1990, at an estimated annual growth rate of 3.2%.[3] The 1990s saw a slowdown in demand growth because of the recession that lasted through the early and middle parts of the decade. The statewide electricity consumption in 1998 was 244,599 GWh, reflecting an annual growth rate of 0.9% between 1990 and 1998 (California Energy Commission 2002a). In 2001, statewide consumption was about 250,000 GWh (California Energy Commission 2002b).

Peak electricity demand, expressed in megawatts (MW), measures the largest electric power requirement during a specified period, usually integrated over one hour. A single MW is enough power to meet the expected electricity needs of 1,000 typical California homes (California Energy Commission 2003b). For comparison, one GW would be enough power for 1,000,000 typical homes. Peak demand is important in evaluating system reliability, determining congestion points on the electrical grid, and identifying potential areas where additional transmission, distribution, and generation facilities might be needed. California's peak demand typically occurs in August between 3 p.m. and 5 p.m. High temperatures lead to increased use of air conditioning, which, in combination with industrial loads, commercial lighting, office equipment, and residential refrigeration, comprise the major consumers of electricity consumption in the peak-demand period in California (California Energy Commission 2000). In 2003, according to CEC, peak electricity demand for California is predicted to be about 52,150 MW.[4] Peak-generating capacity for the state was expected to be about 59,696 MW[5] in 2003 (California Energy Commission 2003c).

Cal-ISO controls the electrical grid that distributes about 82% of the electricity consumed in the state, with the remainder being distributed by municipal utilities. A potential HST system would likely draw most of its electricity from the Cal-ISO-controlled grid, illustrated in Figure 3.5-1.

Electricity Supply and Demand Outlook

The CEC has conducted studies to predict the short- and long-term outlooks for electricity supply and demand balance in California. According to its 2003 staff report, *California's Electricity Supply and Demand Balance over the Next Five Years*, the CEC believes that the near-term

[2] Intermontane and Mohave coal plants are considered to be in-state facilities because they are in Cal-ISO-controlled areas.

[3] Electric energy is measured in watts (W): 1,000 watts is a kilowatt (kW); 1,000 kilowatts is a megawatt (MW); 1,000 megawatts is a gigawatt (GW). Electric consumption over time is measured in kilowatt-hours (kWh), megawatt-hours (MWh), and gigawatt-hours (GWh).

[4] Figure does not include 7% operating reserve.

[5] Figure includes net dependable generating additions of about 3,600 MW, as of July 2003, and forced and planned outages of 3,750 MW. Does not include spot market imports of 3,721 MW.

Figure 3.5-1.
Cal ISO-Controlled Grid

Source: Cal-ISO 2003

outlook for supply adequacy is promising. A 16% operating margin[6] is estimated for summer 2003 (assuming a 1-in-2-year peak temperature condition) in the Cal-ISO-controlled grid where supply is expected to outpace demand by approximately 6,000 MW[7] (California Energy Commission 2003c). According to CEC staff, a statewide planning reserve margin[8] of 8.8% is projected as far out as August 2008, when statewide supply capacity is anticipated to be 64,669 MW, outpacing a statewide projected demand of 59,459 MW[9] (California Energy Commission 2003c). The apparent decline in margins between the summers of 2003 and 2008 is due to the fact that the planning horizon for electric power resource additions is usually only two to three years out and does not necessarily indicate a downward trend in generating capacity.

This short planning horizon interjects uncertainty into the assessment of supply and reserve margin in 2020, the study year for the No Project, Modal, and HST Alternatives. However, the state has added substantial generating capacity in the last two years and it is reasonable to assume it will continue to add capacity. Between 2000 and February 2003, California licensed and added 18 new power plants which have contributed 4,980 MW to the statewide generating capacity. Power plants representing an additional 3,106 MW of generating capacity were anticipated to come online between February 2003 and August 2003 (California Energy Commission 2003d). Statewide demand in 2012 would most likely be around 64,845 MW, assuming normal summer temperatures (California Energy Commission 2002b). Using the growth trend that fits CEC demand predictions through 2012, published in the *2002–2012 Electricity Outlook* (California Energy Commission 2002b), demand for electricity in 2020 can be estimated to be on the order of 77,000 MW.[10] The Cal-ISO estimates that net additions of domestic electricity generation capacity and electricity imports of 1,000 to 1,500 MW/year will be necessary to maintain current operating margins (California Independent State Operator 2002b).

Electricity Transmission Capacity Outlook: Electricity transmission capacity refers to the maximum amount of power that can be carried from the generating source to the utility provider and is a key component in the electrical power delivery system. In the years since the start of the electricity crisis in the summer of 2000, the transmission capabilities of some portions of the state's electrical grid have occasionally been inadequate to transmit electricity at a rate that would satisfy demand. This phenomenon is known as transmission bottlenecks. An example of one such current bottleneck occurs through what is known as Path 15, a major transmission line between northern and southern California through the Central Valley. According to the Western Area Power Administration (WAPA), the Pacific Gas and Electric Company (PG&E) plans to increase the rating of Path 15 from 3,900 MW to 5,400 MW. This process is expected to be completed by 2004 (Western Area Power Administration 2002). Improvements to other transmission paths are also planned, for example the link between California and the Southwest (Palo Verde-Devers Path) and the interconnect with the Tehachapi wind resource area (Consumer Power and Conservation Financing Authority, Energy Resources Conservation and Development Commission, and California Public Utilities Commission 2003).

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[6] *Operating margin* means the percentage by which supply outpaces demand; figure includes a 7% operating reserve in calculation (California Energy Commission 2003b).

[7] Figure includes operating reserve of 5,707 MW.

[8] *Planning reserve margin* differs from operating margin because it does not including the 7% operating reserve in calculation and does not account for forced outages or include spot market purchases. It is used in extended planning horizons (California Energy Commission 2003c).

[9] Demand projection assumes a normal summer. A hot summer increases projected demand to 62,914 MW, which corresponds to a 3.0% planning reserve margin.

[10] Projection to 2020 assumes an average annual growth rate of about 2.0%, with a range from between 1.5% and 3.9%. This projection is for comparison purposes only.

Natural Gas

California is the second largest consumer of natural gas in the nation, with consumption at more than 5.5 billion cubic feet (Bcf) (0.2 billion cubic meters [Bcm]) per day in 1997. Approximately 33% of this total daily consumption was for electricity generation. Residential consumption accounts for 25%, followed by industrial, resource extraction, and commercial. CEC's gas demand forecast projects continued growth at 1.3% annually, with volumes exceeding 7 Bcf (0.2 Bcm) daily by 2019. Natural gas supplies to California will remain plentiful for the next several decades. The total resource base (gas recoverable with today's technology) for the lower 48 states is estimated to be about 975 trillion cubic feet (Tcf) (28 trillion cubic meters [Tcm]), enough to continue current production levels for more than 50 years. Technology enhancements will continue to enlarge this resource base; however, increases to production capacity are less certain (California Energy Commission 1999). Production in the continental U.S. is expected to increase from 19.36 Tcf (0.55 Tcm) in 2001 base year to 32.14 Tcf (0.91 Tcm) in 2020 (U.S. Department of Energy 2003). As of 2001, in-state natural gas production accounted for 15% of total consumption. Out-of-state production areas include the Southwest (50%), the Rocky Mountains (10%), and Canada (25%) (California Energy Commission 2003a).

California's Natural Gas Market: Although California's natural gas market is affected by nationwide price conditions, it has taken steps to insulate itself from the full magnitude of the price swing amplitudes. Starting in 2000 to 2001, during the last major price elevation, the state's natural gas utilities obtained additional interstate pipeline capacity rights on the El Paso Interstate Pipeline in the fall of 2002. This addition allowed the state to maintain adequate inflow rates and reduce harm from price swings. During the recent price spike, pipelines serving California were running at 50% to 70% of capacity, indicating that excess capacity was available if it had been needed. The trend toward more pipeline capacity is being continued in California by projects such as the Kern River Expansion pipeline project, which became operational on May 1, 2003. Utilities in California have also invested in underground storage capacity, an effective mechanism for controlling annual costs that will allow them to dampen the effect of future severe price increases by drawing on stored gas instead of buying high-priced natural gas on the open market. Storage capacity was added in 1999 and in 2002 with the construction of Wild Goose Storage, located in Butte County, which can accommodate 14 Bcf (0.4 Bcm) (with the further expansion of 15 Bcf [0.4 Bcm] expected in 2004) and Lodi Gas, which can accommodate 12 Bcf (0.3 Bcm).

The State of California has also provided utilities with the flexibility and tools to manage gas costs by purchasing natural gas supplies under different contract lengths and pricing terms, and from a variety of supply sources. In addition, California is in the process of increasing its supplies of electricity from renewable power sources such as wind, geothermal, and solar energy. California legislation enacted in 2002 (Senate Bill 1078) created the Renewable Portfolio Standard (RPS) Program which will require retail sellers of electricity to increase their purchases of electricity generated by renewable sources, and establishes a goal of having 20% of California's electricity generated by renewable sources by 2017. Increasing California's renewable supplies will diminish the state's heavy dependence on natural gas as a fuel for electric power generation (California Energy Commission/California Public Utilities Commission 2003).

Relationship between Natural Gas and Electricity Resources in California

Increases in gas prices directly affect the price of electricity because of the large role that natural gas plays in electricity production throughout the Southwest—and in California in particular, where natural gas fueled 42.7% of electricity production in 2001. This percentage is likely to grow as the trend toward building natural gas power plants continues. During the spot-market price spike of February 2003, regional electricity prices rose 45% between early February 2003 and February 24, 2003, and an additional 150% between February 24 and February 26, 2003.

Since late February, natural gas prices have steadily fallen, and prices for electricity have followed suit (California Energy Commission/California Public Utilities Commission 2003).

Notwithstanding the relationship between conditions in the natural gas market and electricity prices, the functioning of the natural gas market, as well as the consequences of price changes in the natural gas market, are fundamentally different from the electricity market. Unlike electricity, natural gas has the property of storability, which gives natural gas an advantage as a commodity over electricity. Because electricity is not storable, a true long-term futures market cannot function as it does for durable commodities, and rates are determined almost solely by electricity spot markets. The lack of a futures market makes electricity rates susceptible to the effects of extreme swings in supply and demand. Conversely, the storability of natural gas provides the advantages that a fairly well-functioning futures market[11] offers with regard to upward pressure that risk puts on prices, and it allows utilities to buy natural gas when prices are low and store it until prices rise. In short, natural gas acts as any other durable commodity in the marketplace, including oil. Short-term shortages are mitigated by the above-stated mechanisms. Long-term price increases are corrected by increases in production capacity, the expectation of which, in turn, acts to bring prices down. Since the projected national in-the-ground natural gas reserves are expected to last for at least the next 50 years, actual supplies are not considered to be limiting, and short- and long-term prices are mostly a function of market conditions, assuming the trend toward improvements in production and transmission capacity continues (California Energy Commission/California Public Utilities Commission 2003).

Transportation Energy Consumption

Transportation accounts for a large portion of the California energy budget, with approximately 46% of the state's energy consumption resulting from the transport of goods and people. Between 1997 and 2020, according to the State Department of Finance, the state is forecasted to grow by about 11 million people, or approximately 30% (California Department of Finance 1998). During this same period, intercity travel is projected to grow by almost 40% to almost 215 million trips per year (California High Speed Rail Authority 2000). Although the average fuel economy of vehicles in the state has improved, the fuel savings achieved are overshadowed by the increased number of miles traveled and the marked shift in personal vehicle preference, from the standard passenger automobile (sedan) toward larger vehicles such as sport utility vehicles (SUVs) and pick-up trucks. Currently, California's 24 million automobiles consume more than 17 billion gal (64 billion L) of petroleum, most of which is consumed in southern California. The state is the third-largest consumer of petroleum fuel in the world. Only the United States as a whole and the former Soviet Union exceed this volume. Because of this dependence on petroleum fuels, events in the international petroleum market can immediately and adversely affect the price and adequacy of California's fuel supply (California Energy Commission 1999).

There are currently four options for intercity travel among the major urban areas of California: automobiles on interstate and state highways, commercial airlines, conventional passenger trains (Amtrak) on freight and/or commuter rail tracks, and long-distance commercial bus transit. These four modes of intercity travel represent a wide range of service characteristics, such as travel time and frequency. Automobiles and airplanes are the predominant modes of intercity trips longer than 150 mi (241 km).

The effects of transportation congestion on energy consumption and air emissions can be major. Automobiles are most efficient when operating at steady speeds of 35 mph to 45 mph (56 kph to 72 kph) with no stops (Oak Ridge National Laboratory 2002). Fuel consumption increases by about 30% when average speeds drop from 30 mph to 20 mph (48 kph to 32 kph), while a drop

[11] The quality of data available to market analysts has been a source of some concern recently, although steps are currently being taken on the national level to remedy this situation.

from 30 mph to 10 mph (48 kph to 16 kph) results in a 100% increase in fuel use. Studies estimate that approximately 10% of all on-road fuel consumed is a result of congestion (California Energy Commission 1990).

The analysis of transportation energy focuses on the overall energy consumption differences between the No Project, Modal, and HST Alternatives. This approach captures the two major transportation fuel inputs, petroleum oil and natural gas (a large component of electricity production). Electricity consumption as a specific item will also be analyzed because of the special nature of electricity, specifically its non-storability and its lack of suitability for trading in futures markets. It is reasonable that the analysis of energy consumed by the HST system is confined to electricity and does not include specific reference to natural gas. The price of natural gas is just one variable in the overall ability of the state's electricity-generating infrastructure to deliver adequate power to users. Moreover, it is not the total reserves of in-the-ground natural gas that is uncertain; it is the market conditions and production capacity trends that affect this commodity, just as is the case for the other major transportation fuel, petroleum oil.

3.5.3 Environmental Consequences

A. EXISTING CONDITIONS COMPARED TO NO PROJECT ALTERNATIVE

In 1997, the number of intercity passenger trips taken between regions of California that would be served by the proposed HST system was about 154 million (Charles River Associates 2000). Of these trips, 98% are attributable to automobiles or airplanes, and only 2% were taken via intercity conventional rail and bus. This result corresponds to 14,237 VMT (22,912 million vehicle kilometers traveled [VKT]) and 62 million airplane VMT (100 million VKT).

In 2020, under the No Project Alternative, the number of intercity passenger trips estimated to be taken in California is projected to be about 215 million (Charles River Associates 2000). This corresponds to about 18,866 million automobile VMT (30,362 million VKT) and 102 million airplane VMT (164 million VKT). The increase in intercity passenger trips is reflective of population growth expected over the same period, which is estimated by the California Department of Finance to be on the order of an additional 11 million people (California Department of Finance 1998).

<u>Operational (Direct) Energy</u>

As indicated in Table 3.5-3, the existing (1997 figures) energy used to power the estimated 154 million intercity passenger trips was 101,525,630 million Btus (MMBtus), or 17.5 million barrels of oil. The 215 million passenger trips estimated under the No Project Alternative would consume the equivalent of about 141,023,720 MMBtus, or 24.3 million barrels of oil. This increase of 39% from existing to No Project conditions would be caused primarily by a population increase of 11 million people. This is a conservative estimate because, as noted in Section 3.5.1, automobile fuel efficiency decreases considerably as travel speed decreases below 30 mph (48 kph) and stop-and-go traffic increases. Since congestion levels under the No Project Alternative would likely be higher than they are under existing conditions, the increase in direct energy used in 2020 would be higher than the projected 39% increase. To illustrate, if the direct energy consumption factor for automobiles under a congested No Project scenario increased by 5%, from 5,669 Btus/VMT to 5,952 Btus/VMT, the total direct energy consumption under the No Project Alternative would increase from 141,023,720 MMBtus to 146,371,202 MMBtus, which would represent a 44% increase over existing levels, compared to the 39% increase in direct energy consumption with the assumption of similar levels of service.

The No Project Alternative would potentially place additional demand on statewide energy supplies compared to existing conditions as a result of increased passenger trips, higher levels of congestion, and slower speeds on intercity highways.

Table 3.5-3
Annual Intercity Operational Energy Consumption in the Study Area

	1997 Existing	2020 No Project Alternative[f]
Annual VMT[b,c,g] (mi [km]) (millions)		
Auto	14,237 (22,912)	18,866 (30,362)
Airplane	62 (100)	102 (164)
HST	0	0
Annual Energy Consumption (Btus) (millions)		
Auto	80,711,153	106,949,635
Airplane	20,814,476	34,074,085
HST	0	0
Total Energy Consumption (MMBtus[a])	101,525,630	141,023,719
Change in Total Energy from Existing (MMBtus[a])		39,498,090
Total Energy Consumption (Barrels of Oil[e]) (millions)	17.5	24.3
Change in Total Energy from Existing (Barrels of Oil[e]) (millions)		6.8

[a] One British thermal unit (Btu) is the quantity of energy necessary to raise 1 pound of water 1 degree Fahrenheit.

[b] VMT based on average number of passengers per vehicle, by mode, as follows:
- Intercity auto: 2.4 passengers/automobile
- Airplane: 101.25 passengers/airplane (70% load factor per Business Plan)

HST VMT based on Business Plan (California High Speed Rail Authority 2000)

[c] Intercity travel only; long distance commute travel not included

[d] Rounded.

[e] One barrel of crude oil is equal to 5.8 MMBtus.

[f] Fuel consumption for No Project would increase beyond the figures presented here as speeds drop below 30 mph (48 kph) on congested highways.

Sources: [g] Charles River Associates 2002, Paul Taylor (Kaku Associates) pers. comm.

Peak-Period Electricity Demand

The No Project Alternative electricity consumption would increase slightly over existing conditions related to the programmed and funded airport expansion under the No Project Alternative. The possible future electrification of Caltrain, commuter rail systems, and/or Amtrak, which, though not part of the current No-Project Alternative, are being considered, would also increase electricity use. While these projects would be regionally significant, they are small in scale compared to overall electricity usage and would be captured by routine electricity consumption forecasts by CEC, allowing electricity generation and transmission planning to account for and accommodate their additions.

Potential electricity demand under the No Project Alternative would be satisfied by expected expansion in generating capacity. No significant potential impacts on electricity generating capacity have been identified.

Construction (Indirect) Energy
The No Project Alternative is based on the assumption that projects currently included in existing plans and programs, including local, state, and interstate transportation system improvements, would be implemented. It is assumed that construction of the projects included in the No Project Alternative would not result in the consumption of energy resources in a wasteful, inefficient, or unnecessary manner.

3.5.4 Comparison of Alternatives by Region

B. NO PROJECT ALTERNATIVE COMPARED TO MODAL AND HST ALTERNATIVES (with sensitivity analysis ridership forecasts)

Operational (Direct) Energy
The 39% increase in energy use of the No Project Alternative over existing conditions is similar to the potential increase that would be expected with implementation of the proposed Modal Alternative, which would increase direct energy consumption by 40% over existing conditions, as summarized in Table 3.5-4. By contrast, the proposed HST Alternative would increase direct energy consumption by 10% over existing conditions, a much slower rate than the Modal or No Project Alternatives.

Statewide: As indicated by the VMT-based analysis, energy requirements for intercity transportation would be greater under the Modal Alternative than under the No Project Alternative because of induced demand for automobile travel related to extra highway capacity. Table 3.5-4 shows that, although the number of airplane VMT would remain the same under Modal and No Project Alternatives,[12] the number of automobile intercity trips taken would increase statewide by 1.1% over the No Project Alternative,[13] which would increase the number of annual VMT by 208 million (335 million VKMT) to 19,073 million (30,695 million VKMT). These additional VMT translate into an additional energy use of 1,176,446 MMBtus, which is the equivalent of 0.2 million barrels of oil. However, as indicated in Section 3.5.1, automobile fuel efficiency decreases considerably as travel speeds decrease and stop-and-go traffic increases. This means that the higher energy consumption resulting from more VMT would be offset by the Modal Alternative's lower level of congestion in rural highway segments. For example, if the direct energy consumption factor for automobiles increased by 5% because of congestion under the No Project Alternative, from 5,669 Btus/VMT to 5,952 Btus/VMT, the total energy consumption under No Project would increase from 141,023,720 MMBtus to 146,371,202 BTUs. In this scenario, the Modal Alternative would consume 3% less direct energy than No Project. This compares to a 1% increase in direct energy consumption when comparing the Modal Alternative to a more congested No Project Alternative.

By comparison, the HST Alternative would potentially decrease intercity automobile VMT from 18,865 million (30,360 million VKT) under the No Project Alternative scenario to 15,816 million (25,453 million VKT), decrease airplane VMT from 102 million (164 million VKT) to 1 million (2 million VKT), and increase HST VMT attributable to intercity trips from 0 to 22 million (35 million VKT). Under the HST Alternative, commuter automobile VMT (based on 1.0 passenger per automobile) would also potentially decrease by 509 million VMT (819 million VKT) compared to the No Project Alternative, although HST VMT attributable to commuter trips would increase from 0 to 2 million (3 million VKT). Where the HST system would use 20,304,566 MMBtus for trips related to intercity travel, the overall direct energy for intercity

[12] It is assumed that an increase in the level of service for air travel under the Modal Alternative compared to the No Project Alternative would not increase the number of trips, but instead would meet peak travel demand. This could also be thought of as satisfying rush hour demand.

[13] Trips that would be induced (also called latent demand) as a result of the improved level of service.

travel would be 30,717,124 MMBtus, or the equivalent of 5.2 million barrels of oil, less per year than the 2020 No Project Alternative. This potential reduction represents a 22% energy savings for intercity trips over the No Project Alternative and a 9% increase over direct energy consumption under existing conditions (1997). Proposed HST operations related to commuter travel would use 1,630,199 MMBtus. However, the 10 million commute-related passenger trips that could be diverted from automobiles to the proposed HST system would result in a potential decrease in energy use by automobiles of 2,886,699 MMBtus. This would result in a net reduction in commute-related direct energy consumption of 1,256,500 MMBtus, compared to the No Project Alternative.

Table 3.5-4
Annual Intercity Operational Energy Consumption in Study Area

	1997	2020		
	Existing	No Project Alternative	Modal Alternative	HST Alternative
Annual VMT[b, c, g] (mi [km]) (millions)				
Auto	14,237 (22,912)	18,866 (30,362)	19,073 (30,695)	15,816 (25,453)
Airplane[d]	62 (100)	102 (164)	102 (164)	1 (2)
HST	0	0	0	22 (35)
Annual Energy Consumption (MMBtus[a])				
Auto	80,711,153	106,949,635	108,126,081	89,661,289
Airplane	20,814,476	34,074,085	34,074,085	340,741
HST	0	0	0	20,304,566
Total Energy Consumption (MMBtus)	101,525,630	141,023,720	142,200,166	110,306,596
Change in Total Energy from Existing (MMBtus)		39,498,090	40,674,536	8,780,967
Change in Total Energy from No Project (MMBtus)			1,176,446	-30,717,124
Total Energy Consumption (Barrels of Oil[f]) (millions)	17.5	24.3	24.5	19.1
Change in Total Energy from Existing (Barrels of Oil[f]) (millions)		6.8	7.0	1.5
Change in Total Energy from No Project (Barrels of Oil[f]) (millions)			0.2	-5.2

[a] One British thermal unit (Btu) is the quantity of energy necessary to raise 1 pound of water 1 degree Fahrenheit.

[b] VMT based on average number of passengers per vehicle, by mode, as follows:
- Intercity auto: 2.4 passengers/automobile
- Airplane: 101.25 passengers/airplane (70% load factor)

HST VMT based on Business Plan (California High Speed Rail Authority 2000)

[c] Intercity travel only; long-distance commute travel not included.

[d] Does not include airplane VMT resulting from passengers making connections to other flights to continue or complete their journey because these are a minor portion of the HST-served market.

[e] Rounded.

[f] One barrel of crude oil is equal to 5.8 MMBtus.

[g] Fuel consumption for the No Project Alternative would increase beyond the figures presented here as speeds drop below 30 mph on congested highways.

Sources: [h] Charles River Associates 2002; Paul Taylor (Kaku Associates) pers. comm.

The VMT-based energy calculations above do not account for congestion levels. As congestion levels decrease, so does vehicular energy use for transportation. Therefore, the 22% energy consumption reduction projected under the HST Alternative is probably conservative because intercity route congestion levels would be expected to lessen in rural areas if it is implemented. Using the example of a 5% increase in the energy consumption factor for automobiles due to congestion, explained above under Modal Alternative, a congested No Project Alternative could hypothetically result in direct energy consumption of 146,371,202 MMBtus, compared to the 141,023,720 MMBtus anticipated in a less-congested No Project scenario. The congested scenario would result in additional intercity potential direct energy savings with the proposed HST Alternative of about 5,347,482 MMBtus, which would represent a potential 17% increase in the amount of energy saved. Thus, the total energy savings with the proposed HST Alternative and high-end ridership could be as great as 25% over the No Project Alternative.

An energy intensity analysis of the alternatives was also calculated using passenger miles traveled (PMT) for each of the modes. This is useful for anticipating how each of the alternatives would affect energy use. Table 3.5-5 lists the energy consumption factors of each of the modes. HST service offers a sharp reduction in energy consumption per passenger mile compared to other modes.

Table 3.5-5
Energy Consumption Based on Passenger Miles Traveled (PMT)

Mode	Energy Consumption[e]
Intercity Passenger Vehicles (Auto, Van, Light Truck) [a]	2,400 Btus/PMT
Commute Passenger Vehicles (Auto, Van, Light Truck) [b]	5,700 Btus/PMT
Airplanes[c]	3,300 Btus/PMT
High-Speed Trains[d]	1,200 Btus/PMT

[a] Based on 2.4 passengers per vehicle.
[b] Based on 1.0 passenger per vehicle.
[c] Based on 101.25 passengers per vehicle (70% load factor).
[d] Based on 761 passengers per 16-car trainset (63% load factor, which accommodates projected 2020 sensitivity case high-end demand for HST service within the existing Business Plan).
[e] Rounded.

Regional: In addition to the statewide direct automobile VMT savings that would result from travelers choosing HST travel, the proposed HST Alternative would potentially provide additional regional VMT reductions, compared to the No Project Alternative conditions. Proposed HST station-stops would be more numerous than airports, which would result in a lessening of the average distances required for passengers to travel from their points of origin to the mode transfer point (and vice versa) because of the likelihood that one or more of the stations would be closer to their point of origin than would their respective regional airport.

Implementation of the HST Alternative would also potentially decrease regional transportation-related energy consumption through proposed improvements to rail corridors in the Bay Area to Merced and Los Angeles to San Diego via Orange County (LOSSAN) regions. Grade separations are proposed for Caltrain and the LOSSAN corridor as part of the proposed HST system, which would increase traffic flow in the affected areas, thereby increasing fuel efficiency and decreasing energy consumption.

The comparison of the Modal and HST Alternatives to the No Project Alternative shows that only the proposed HST Alternative would potentially decrease energy use statewide. Compared to the Modal Alternative, the HST Alternative would save 31,893,570 MMBtus, or about 5.5 million barrels of oil annually, which equates to an approximate 22% savings. Regional analysis indicates that regional efficiencies, which would be precipitated by implementing the proposed HST Alternative, would increase these projected savings.

The Modal Alternative would have no potential impact because it would likely consume about the same, if not slightly less, energy than the No Project Alternative because of reduced congestion.

Peak-Period Electricity Demand

The small projected increase in electricity demand over existing conditions with the No Project Alternative would be somewhat smaller than what would be expected with implementation of the Modal Alternative. Conversely, the proposed HST Alternative would increase electricity demands on the state's generation and transmission infrastructure, increasing peak demand on the order of 480 MW[14].

Statewide: Compared to the No Project Alternative, there would be some increase in electricity demand in the peak period under the Modal Alternative due to new/expanded airport facilities. It would be small, and it would be covered by CEC projections of electricity demand and supply capacity.

By comparison, electrical power demanded by the HST system would increase the load on the statewide system on the order of 480 MW during peak electricity demand in 2020. Electricity supply and demand projections are not available for 2020. Such a long-time horizon has uncertainty, especially on the supply side, where capacity additions are difficult to predict more than two to three years into the future. However, it is useful to compare the expected HST-related operational electricity demand to surplus projections through 2008, the year that is farthest into the future for which electricity production capacity projections are available. CEC estimates that statewide electricity surplus generating capacity[15] in 2008 will be 5,210 MW, based on a total generating capacity of 64,669 MW and a demand of 59,459 MW (California Energy Commission 2003c). If the system were to become operational in 2008, the additional load (i.e., demand) placed on the system by the HST Alternative would be about 10% of the state's anticipated electricity surplus. Prediction horizons for demand estimates are longer than for capacity additions. The additional 480-MW load that would be placed on statewide electricity generating resources by the HST Alternative would represent approximately 0.7% of the CEC-predicted 2012 statewide electricity demand of 64,845 MW. Projecting the demand horizon to the study year of 2020, the HST Alternative-generated load would represent 0.6% of an estimated 77,000 MW statewide demand.[16] Though the HST Alternative could cause potentially considerable impacts on the state's electricity grid if the generation and transmission capacity were not equipped to handle the additional load, the short-term electricity generation outlook is favorable, and the medium- to long-term demand scenarios indicate that the proposed HST Alternative would represent a very small portion of statewide demand.

[14] Figure based on an average electricity use of 74.2 kW/train mi, which equates to an average electricity use rate of about 12 MW per trainset when integrated over 1 hour. These are averages and do not reflect acceleration or changes in grade; they are for planning purposes only.

[15] This assumes a normal summer and including existing generation, retirements, high-probability California additions, net firm imports, and spot-market imports.

[16] Calculation based on CEC demand projections from 2002 to 2012 for normal temperature years, published in *2002–2012 Electricity Outlook* (California Energy Commission 2002b). Projection to 2020 assumes an average annual growth rate of about 2.0% with a range from between 1.5% and 3.9%. This projection is for comparison purposes only.

The demand growth extrapolation based on CEC demand predictions assumes an average annual electricity demand growth in California on the order of 1,400 MW through 2020, about three times the 480-megawatt load that the HST operations are expected to place on the statewide system. The HST Alternative would be built and become operational in stages, which indicates that, instead of placing an additional 480-MW load on the state's production and transmission resources abruptly, the system would gradually increase its electricity consumption rate to 480 MW. A first segment from Los Angeles to San Francisco, for example, would place an additional load on electricity resources on the order of 350 MW,[17] which is about 72% of the load anticipated for the entire system. This gradual increase would allow the in-state and out-of-state electricity generation and transmission industries and planners to anticipate and respond to the effects of the proposed HST Alternative on generating and transmitting resources.

Regional: Regional impacts on the electricity grid could occur if the proposed HST Alternative contributed to electricity transmission deficiencies, or bottlenecks, which were described in Section 3.5.2. If bottlenecks were to be aggravated by the HST Alternative, a potential adverse impact could result. However, through careful HST electrification design (i.e., design system so that it draws power from the electricity grid at several places throughout the state), it would be possible to minimize or eliminate such potential problems. Also, bottlenecks in the current grid system are being addressed by such projects as the Path 15 upgrade (see Section 3.5.2). If planning transmission line capacity continues to grow to anticipate statewide needs, the HST Alternative would not have the potential to cause a significant impact on transmission. The Modal Alternative is not expected to cause substantial electricity demand increases in any of the regions.

The HST Alternative could cause potentially considerable impacts on the state's electricity grid if the generation and transmission capacity were not equipped to handle the additional load. However, the short-term electricity generation outlook is favorable, and the medium- to long-term demand scenarios indicate that the proposed HST Alternative would represent a very small portion of statewide demand. If current trends continue as expected, electricity generation and transmission capacity would satisfy the underlying growth in demand, estimated to average about 2% per year. The HST Alternative would represent a small percentage of generating and transmission capacity required to satisfy projected overall demand. Staging of the completion of construction and the start of major operations would make the load additions by each of the HST Alternatives less abrupt than would be the case if the start of the full planned operations were to occur simultaneously.

Construction (Indirect) Energy

Construction of the programmed and funded transportation improvements under the No Project Alternative would require less energy than construction of either the Modal or HST Alternative.

Project Construction: The Modal Alternative construction-related energy consumption would result in the one-time, non-recoverable energy costs associated with construction of new/expanded airport runways, airport facilities, roadways—an estimated 2,970 lane-mi (4,780 km) statewide—interchanges, ramps, and other support facilities (e.g., rest areas, maintenance facilities). The HST Alternative construction-related energy consumption would also result in a one-time, non-recoverable energy cost, which would occur during construction of on-the-ground, underground and aerial facilities such as trackwork, guideways, structures, maintenance yards, stations, and support facilities. Details regarding energy conservation practices have not been specified for the HST Alternative, which has not been designed in detail,

[17] Figure determined by using the proportion of train-miles programmed into the operating plan between Los Angeles and San Francisco to the total number of train-miles for the entire completed project. Assumes that the rest of the operating plan (i.e., peak frequency) would remain the same.

nor have construction methods and staging been planned at this time. Given the scope and scale of the improvements proposed as part of the HST Alternative, however, it is anticipated that the construction-related energy requirement would be substantial. Table 3.5-6 shows estimates of potential construction-related indirect energy consumption for both the Modal and HST Alternatives.

Table 3.5-6
Non-Recoverable Construction-Related Energy Consumption

Alternative	Structure	Rural vs. Urban[a]	Facility Quantity[b]	Energy Consumption[c] (MMBtus)
Modal	Highway (at grade)	Rural	1,476 one-way lane mi (2,375 km)[d]	25,187,000
		Urban	795 one-way lane mi (1,279 km)[d]	20,879,000
	Highway (elevated)	Rural	455 one-way lane mi (732 km)[d]	59,323,000
		Urban	245 one-way lane mi (394 km)[d]	80,191,000
	Subtotal			185,580,000
	Airport (runway)	N/A	6 runways	37,872,000
	Airport (gates)	N/A	91 gates	7,098,000
	Subtotal			44,970,000
	Modal Alternative total			230,550,000
HST	HST guideway (at grade)	Rural	2,263 guideway mi (3,642 km)	27,807,000
		Urban	640 (1,030 km)	12,224,000
	HST guideway (elevated)	Rural	333 guideway mi (536 km)	18,442,000
		Urban	161 (259 km)	8,972,000
	HST guideway (below grade, cut)	Rural	19 guideway mi (31 km)	2,239,000
		Urban	30 (48 km)	4,868,000
	HST guideway (below grade, tunnel)	Rural	242 guideway mi (389 km)	28,322,000
		Urban	146 (235 km)	47,958,000
	HST station	N/A	20 stations	1,560,000
	HST Alternative total			152,390,000

[a] Assumes the HST and Modal Alternatives would be constructed in rural and urban areas at the following proportions:
- Bay Area to Merced: Rural (70%), Urban (30%)
- Sacramento to Bakersfield: Rural (95%), Urban (5%)
- Bakersfield to Los Angeles: Rural (70%), Urban (30%)
- LOSSAN: Rural (30%), Urban (70%)
- Los Angeles to San Diego via Inland Empire: Rural (60%), Urban (40%)

[b] Measured in guideway miles for non-discrete structures (e.g., highways and HST guideways), and in structure quantities for discrete structures (e.g., airport runways and terminals, and HST stations).

[c] Rounded.

[d] Based on 2,970 mi (4,780 km) of highway lane additions; distribution between at-grade (65%) and elevated (35%) estimated for comparison purposes. True values are not known at current level of planning.

[f] Differences between the construction-related energy consumption for urban and rural settings reflect differences in construction methods, demolition requirements, utility accommodation, etc.

As shown in the table, the construction of the proposed HST Alternative would consume 34% less energy during construction than the Modal Alternative. Assuming that the 2020 energy savings for each of the system alternatives remain constant, and assuming an un-congested No Project scenario, the Modal Alternative would not repay the construction energy estimated to be consumed as a result of its implementation because more operational energy would be consumed by the Modal Alternative than by the No Project Alternative. If a 5% increase in the No Project Alternative automobile operational energy is assumed, the Modal Alternative would consume less energy than this congested No Project Alternative and would result in a construction energy payback period of 55 years. Energy savings projected for the proposed HST Alternative would repay the construction energy consumption in 5 years with an uncongested No Project scenario and would have a 4-year payback period if a 5% automobile congestion energy consumption penalty is assumed.

Secondary Facilities: It is reasonable to assume that secondary facilities, such as those used in the production of cement, steel, etc., would employ all reasonable energy conservation practices in the interest of minimizing the cost of doing business. Industry in California reduced electricity usage (which is mostly generated by natural gas, a nonrenewable fuel) from 54.7 million MWh in 2000 to 52.2 million MWh in 2001, a 4.6% reduction, even as the state's population increased by 513,352, or 1.5% (California Energy Commission 2002d). Therefore, it can reasonably be assumed that construction-related energy consumption by secondary facilities would not consume nonrenewable energy resources in a wasteful, inefficient, or unnecessary manner under either the Modal or HST Alternative.

Construction of either the Modal or HST Alternative is anticipated to take about 10 years, beginning in 2005 and finishing in 2016. Construction would occur in stages, and some segments would be open for operation while others are still under construction. Given the scope and scale of the Modal and HST Alternatives, it is anticipated that secondary construction-related energy requirements would be substantial.

Due to the scope and scale of the improvements proposed as part of the Modal and HST Alternatives, construction-related energy impacts, both project and secondary, would be potentially significant. Though the construction energy consumption factors presented in Table 3.5-6 indicate that the HST Alternative would consume less energy during construction than the Modal Alternative, how much less is unknown because limited data is available. Construction of the Modal and HST Alternatives would potentially represent a significant use of nonrenewable resources.

C. NO PROJECT ALTERNATIVE COMPARED TO MODAL AND HST ALTERNATIVES (with investment-grade ridership forecasts)

Operational (Direct) Energy

Statewide: Based solely on VMT, the HST Alternative with the investment-grade ridership forecast would potentially reduce overall direct energy use for intercity travel in 2020 by 11,749,680 MMBtus, or the equivalent of 2.0 million barrels of oil compared to the No Project Alternative, as shown in Table 3.5-7. This reduction represents an 8% energy savings for intercity trips over the No Project Alternative, and a 27% increase over direct energy consumption under existing conditions (1997). This compares to a 22% reduction over the No Project Alternative and a 9% increase over existing conditions (1997) with the high-end sensitivity analysis ridership forecast. Using the example of a 5% increase in the energy consumption factor for automobiles under congested No Project conditions, intercity direct energy savings with the HST Alternative would be 17,097,162 MMBtus with the assumption of investment-grade ridership projections, compared to a savings of 36,064,605 million Btus with

the high-end ridership forecast. Commuter diversion to HST would not change with the investment-grade forecast.

Table 3.5-7
Annual Intercity Operational Energy Consumption in Study Area
(Assuming Investment-Grade Ridership Forecasts)

	1997	2020		
	Existing	No Project Alternative[g]	Modal Alternative[e]	HST Alternative[e]
Annual VMT[b,c,h] (mi [km]) (millions)				
Auto	14,237 (22,912)	18,866 (30,362)	19,073 (30,695)	17,367 (27,949)
Airplane[d]	62 (100)	102 (164)	102 (164)	41 (66)
HST	0	0	0	22 (35)
Annual Energy Consumption (MMBtus)				
Auto	80,711,153	106,949,635	108,126,081	98,458,799
Airplane	20,814,476	34,074,085	34,074,085	13,556,367
HST	0	0	0	17,258,873
Total Energy Consumption (MMBtus[a])	101,525,630	141,023,720	142,200,166	129,274,040
Change in Total Energy from Existing (MMBtus[a])		39,498,090	40,674,536	27,748,410
Change in Total Energy from No Project (MMBtus[a])			1,176,446	-11,749,680
Total Energy Consumption (Barrels of Oil[f]) (millions)	17.5	24.3	24.5	22.3
Change in Total Energy from Existing (Barrels of Oil[f]) (millions)		6.8	7.0	4.8
Change in Total Energy from No Project (Barrels of Oil[f]) (millions)			0.2	-2.0

[a] One British thermal unit (Btu) is the quantity of energy necessary to raise 1 pound of water 1 degree Fahrenheit.

[b] VMT based on average number of passengers per vehicle, by mode, as follows:
- Intercity auto: 2.4 passengers/automobile
- Airplane: 101.25 passengers/airplane (70% load factor)

HST VMT based on Business Plan (California High Speed Rail Authority 2000).

[c] Intercity travel only; long-distance commute travel not included.

[d] Does not include airplane VMT resulting from passengers making connections to other flights to continue or complete their journey, because they are a minor portion of the market served by HST.

[e] Rounded.

[f] One barrel of crude oil is equal to 5.8 MMBtus.

[g] Fuel consumption for the No Project Alternative would increase beyond the figures presented here as speeds drop below 30 mph (48 kph) on congested highways.

Sources: [h] Charles River Associates 2002, Paul Taylor (Kaku Associates) pers. comm.

With the investment-grade HST ridership projections, the energy consumption per passenger mile traveled on the HST would be about 1,800 Btus, compared to about 1,200 Btus when the high-end ridership forecast is assumed.

Regional: Regional energy savings with investment-grade ridership projections for the HST Alternative compared to the No Project Alternative would not be qualitatively different from those expected with the sensitivity analysis variations in the ridership forecast.

Peak-Period Electricity Demand
Whereas the proposed HST system would consume electricity at the rate of 480MW when fully operational with the sensitivity analysis variations in the ridership forecast, which would generally require 16-car trainsets to accommodate the expected passenger demand, the HST system would consume electricity at the reduced rate of 410MW[18] with the investment-grade ridership forecast, which would generally require 12-car trainsets to accommodate passenger demand.

Construction (Indirect) Energy
The HST Alternative would have a payback period of 12 years with the investment-grade ridership projections, compared to 5 years with the sensitivity analysis variations in the ridership forecast. Assuming a 5% increase in No Project automobile energy consumption due to congestion, the HST Alternative would have a payback period of 9 years with the investment-grade ridership projections, compared to 4 years with the sensitivity analysis variations in the ridership forecast.

3.5.5 Design Practices

The proposed electrically powered HST technology is energy efficient, requiring substantially less energy than other modes of intercity travel. Implementation of the HST Alternative is anticipated to reduce energy use over the No Project or Modal Alternatives.

3.5.6 CEQA Significance Conclusions and Mitigation Strategies

Based on the analysis above, and considering the discussion in CEQA Appendix F on Energy Conservation, the HST alternative would have a potentially significant effect related to long term electric power consumption when viewed on a system-wide basis. It is calculated that the HST alternative would contribute to statewide electricity demand by adding demand which is about 0.6% of projected statewide electricity demand in 2020. While this is an increase, the HST alternative represents a more energy efficient mode of transportation than travel by aircraft or car, such that the HST alternative would result in an overall reduction in total energy consumption (combined electric power demand and oil consumption). Mitigation strategies, as well as the design practices discussed in section 3.5.5, will be applied to reduce this impact.

This is a broad program-level analysis reviewing potential statewide energy use and impacts related to the proposed HST system and other alternatives. If the proposed HST Alternative were implemented, the HST system would be designed to minimize electricity consumption. The design particulars would be developed at the project-level of analysis, but would they include the following.

- Use regenerative braking to reduce energy consumption of the system.
- Minimize grade changes in steep terrain areas to reduce the use of electricity during peak periods.
- Use energy-saving equipment and facilities to reduce electricity demand.
- Maximize intermodal transit connections to reduce automobile VMT related to the HST system.
- Develop and implement a construction energy conservation plan.

[18] Based on an average electricity use of 63.07 kW/train mi, which equates to an average electricity use rate of the order of 10 MW per trainset when integrated over 1 hour. The rate of electricity use by a 12-car trainset was assumed to be 85% of the rate used by a 16-car trainset. These are averages and do not reflect acceleration or changes in grade; they are for planning purposes only.

- Develop potential measures to reduce energy consumption during operation and maintenance activities.

It is important to note that the proposed HST system is anticipated to reduce energy consumption overall. Any localized energy impacts would be avoided through proper planning and design of power distribution systems and their relationship with the overall power grid. The following measures could further reduce HST alternative energy consumption.

- Locate HST maintenance and storage facilities within close proximity to major stations/terminals.
- Locate construction material production facilities on-site or within close proximity to the project site.
- Use of newer, more energy efficient construction vehicles.
- Implementation of a program to encourage construction workers to carpool or use public transportation for travel to and from the construction site.

The above mitigation strategies are expected to reduce the short-term and long-term electric power consumption impacts of the HST alternative to a less-than-significant level. Additional environmental assessment will allow a more precise evaluation in the second-tier, project-level environmental analyses.

3.5.7 Subsequent Analysis

Subsequent analysis would be required in project-level environmental documentation for the proposed HST Alternative, if selected. Detailed analysis of base and peak-period electricity requirements and transmission infrastructure would be required to more precisely assess the adequacy of electricity generation and transmission capacity relative to demand for each segment to be pursued. Comprehensive traffic analysis for future conditions would be required to assess regional energy impacts in more detail for each segment.

Subsequent energy analysis at the project level would follow the methodology applied in this evaluation, but would employ the more detailed traffic and electrical input data for the energy consumption analysis. Energy consumption factors would be updated using the latest available published information. Detailed construction staging, sequencing, methods, and practices would be necessary to support a quantitative analysis of construction energy consumption.

3.6 ELECTROMAGNETIC FIELDS AND ELECTROMAGNETIC INTERFERENCE

This section describes the potential impacts of electromagnetic fields (EMFs) associated with operation of the No Project, Modal, and High-Speed Train (HST) Alternatives. The principal topics discussed in this section are potential impacts on personal health and potential impacts on electronic and electrical devices as a result of electromagnetic interference (EMI).

3.6.1 Regulatory Requirements and Methods of Evaluation

A. REGULATORY REQUIREMENTS

Neither the federal government nor the State of California has established regulatory limits for EMF exposure. The Federal Communications Commission (FCC) regulates sources of radiofrequency (RF) fields to maintain the quality of wireless communications across the spectrum. The FCC, which does not regulate for health and safety, has adopted regulations applicable to EMF exposure that were derived from health and safety evaluations made by the American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE) and the National Council on Radiation Protection (NCRP). FCC regulations would apply to intentional radiators such as the proposed HST wireless systems for both operational and amenity purposes. FCC regulations would otherwise apply only if HST operations (RF interference) interfered with legitimate spectral uses.

Voluntary standards for EMF exposure have been developed by the International Committee on Electromagnetic Safety (ICES), which is sponsored by IEEE. The federal and state governments do not enforce these voluntary standards. The standards are based on studies of electrostimulation (i.e., nerve and muscle responses to the internal electric field in the body). ICES standards recommend maximum permissible 60-Hz magnetic field exposure levels that are a few thousand times higher than 0.3 to 0.4 microtesla (μT) (3 to 4 milligauss [mG]). Magnetic fields greater than 0.3 to 0.4 μT are relatively uncommon exposures that are found in a small percentage of homes that have been shown to have a possible association with childhood leukemia based on inconclusive evidence (National Institute of Environmental Health Sciences 1998, 1999; International Agency for Research on Cancer 2002). Unresolved scientific issues concerning health effects of power frequency extremely low frequency (ELF) magnetic fields were examined extensively by the California Department of Health Services (Neutra et al. 2002) in response to a request from the California Public Utilities Commission. There is no evidence to substantiate a relationship between ELF electric fields and cancer (International Agency for Research on Cancer 2002), and the low-level electric fields typically found in homes have not been associated with other diseases (National Institute of Environmental Health Sciences 1998; Institute of Electrical and Electronic Engineers 2002). The ANSI/IEEE standards; NCRP recommendations, International Commission on Non-Ionizing Radiation protection (ICNIRP) guidelines, American Conference of Governmental Industrial Hygienists, Inc. (ACGIH) guidelines suggest maximum permissible 60-hertz (Hz) electric field levels for public exposure at 4.2 to 10 kilovolts (kV) per meter.

B. METHOD OF EVALUATION OF IMPACTS

The Modal and HST Alternatives were analyzed for EMF/EMI by a search of existing literature and expert opinion (volunteer scientists and engineers from academia and industry working in accordance with IEEE rules) based on that literature. Issues concerning EMF[1] biological and health effects at all frequencies of concern for the HST alternative are the subject of the scientific discipline known as bioelectromagnetics, which is served by The Bioelectromagnetics Society, other scientific organizations, and an extensive scientific literature that has been critically reviewed by scientific expert committees convened by a number of national and international bodies. This body of

[1] EMF covers ELF and RF forms of electric and magnetic fields, and electromagnetic fields.

information is used in this Program EIR/EIS to describe the potential effects for each of the system alternatives. The medical and scientific communities have been unable to determine whether usual residential exposures to EMFs cause health effects or to establish any standard or level of exposure that is known to be either safe or harmful.

3.6.2 Affected Environment

A. STUDY AREA DEFINED

The study area for EMF/EMI associated with operation of the alternatives is limited to potentially affected land uses and populations in the vicinity of the alternative corridors.

B. GENERAL DISCUSSION OF ELECTROMAGNETIC FIELDS

EMFs occur both naturally and as a result of human activity. Naturally occurring EMFs include those caused by weather and the earth's magnetic field. EMFs also are generated by technological application of the electromagnetic spectrum for uses such as the generation, transmission, and local distribution of electricity; electric appliances; communication systems; marine and aeronautical navigation; ranging and detection equipment; industrial processes; and scientific research.

EMFs are described in terms of their frequency, or the number of times the electromagnetic field changes direction in space each second. Natural and human-generated EMFs encompass a broad frequency spectrum. In the United States, the electric power system operates at 60 Hz, or cycles per second, meaning that the field reverses its direction 60 times per second. In Europe, some parts of Japan, and many other regions, the frequency of electric power is 50 Hz. Radio and other communications operate at much higher frequencies; many are in the range of 500,000 Hz (500 kilohertz) to 3 billion Hz (3 gigahertz). In areas not immediately adjacent to transmission lines, 60-Hz EMFs exist because of electric power systems and uses such as building wiring and electrical equipment or appliances.

The strength of magnetic fields often is measured in μT or mG. As a baseline for comparison, the geomagnetic field ranges from 50 to 70 μT (500 to 700 mG) at the surface of the earth. Research on ambient magnetic fields in homes and buildings in several western states has found average magnetic field levels within rooms to be approximately 0.1 μT (1 mG), while measured values range from 0.9 to 2.0 μT (9 to 20 mG) in the immediate area of appliances (Severson et al. 1988, Silva et al. 1988).

Depending on the configuration of the source, the strength of an EMF decreases in proportion to distance or distance squared, or even more rapidly. Because the rate of decrease and the distance at which impacts become insignificant depend on technical specifications such as the source's geometric shape, size, height above the ground, and operating frequency, it is not possible to define a characteristic distance for the extent of field effects that applies in general for all sources. Because of their rapid decrease in strength with distance, EMFs in excess of background levels are likely to be experienced only comparatively near sources. Consequently, only persons on or in close proximity to the proposed HST system would be likely to experience such increases, and while HST operations could introduce some very low but measurable changes in 60-Hz magnetic fields up to 1,000 feet or more from the right-of-way, these low-level changes are not known to be hazardous. ELF is variously defined as having a lower limit of greater than zero (3 or 30 Hz) and an upper limit of 30, 100, 300, or 3000 Hz. The HST catenary and distribution systems will primarily have 60-Hz fields.

In addition to the 60-Hz EMFs generated by the power supply system, the HST Alternative would generate incidental RF fields, and would also use RF fields for wireless communications. The 60-Hz electric and magnetic fields from power-supply systems would occur everywhere near the energized conductors, but only the magnetic fields would vary in strength depending on load. Load would

depend on the number of trains in the segment and their operating conditions (acceleration, speed, weight of vehicles, passengers and freight, grade). Hence, in time, the magnetic fields (MFs) are variable, whereas the electric fields (EFs) are constant. Similarly, EFs along the route would be similar for a given distribution and transmission voltage, whereas MFs along the route would depend on nearby loads. Therefore, daily MF averages would differ for different locales because of different local HST traffic. The information presented in this document primarily concerns EMFs at power frequencies of 50 or 60 Hz, and RFs produced intentionally by HST communications or unintentionally by electric discharges (arcing) between the catenary wire and the train's power pickup and other sources of corona discharge typical of high-voltage systems. EMI occurs when the EMFs produced by a source adversely affect operation of an electrical, magnetic, or electromagnetic device. EMI may be caused by a source that intentionally radiates EMFs (e.g., a broadcast station) or one that does so incidentally (e.g., an electric motor).

C. POTENTIALLY AFFECTED LAND USES AND POPULATIONS

Public and occupational exposure to EMFs is widespread and encompasses a broad range of field intensities and durations. Land uses of interest for potential impacts from exposure to EMFs are residences, schools, and daycare centers along the corridors for each of the alternatives. Specialized uses of interest for evaluation for possible sensitivity to EMI are wireless communication, health care, scientific, and military facilities. These facilities may be used for purposes that include public safety, commerce, radio and television broadcasting, scientific research, commercial fabrication, and military testing and operations. The levels of EMF generation are unlikely to impair radio and radar communications at an airport because of the distance between the control tower and the proposed alignments. Transportation alignments may abut property used for educational, medical, religious, and athletic activities. In rural settings, land is largely undeveloped or in agricultural use but can have any of the other uses noted for urban and suburban areas. In addition, transportation passengers and workers would be exposed to EMFs in or below the range of EMFs generated by other rapid transit and electric railroad systems.

3.6.3 Environmental Consequences

A. EXISTING CONDITIONS COMPARED TO NO PROJECT ALTERNATIVE

Under the No Project Alternative, EMFs along existing roadways and railroad rights-of-way would be affected by technological developments in the period before 2020 and by technology- and population-driven changes in total energy consumption. General EMF levels may increase because of massive implementation of low-level RF and infrared for radar and radar-like purposes, as well as possible wireless data transfer for vehicle control by advanced automotive technologies such as collision-avoidance systems and automatic vehicle guidance systems implemented on freeways and highways. Expansion of conventional rail and transit systems using electric propulsion would also increase levels of ELF magnetic fields near new electrical infrastructure. However, any changes in transmission line loads would not directly change residential magnetic fields significantly (Swanson 1996). In addition, the large-scale use of electrically powered automobiles could increase general EMF exposure. The No Project Alternative is not likely to cause significant changes in EMF levels, or human exposure to EMFs or EMI.

B. NO PROJECT COMPARED TO MODAL AND HIGH-SPEED TRAIN ALTERNATIVES

<u>Modal Alternative</u>
Under the Modal Alternative, improvements to airports may increase EMFs because of increased use of radar, radio communications, and instrument landing systems. ELF magnetic fields produced by the electric power system would increase because of additional power used by new or enlarged terminal facilities. However, an expanded airport operation would be local to the facility (control tower) and lines immediately serving it, not a general effect on surrounding

neighborhoods or communities (noting that general residential magnetic field exposures are not directly related to transmission line loads) (Swanson 1996). Therefore, the Modal Alternative is not likely to cause significant changes in EMF levels, or human exposure to EMFs or EMI.

High-Speed Train Alternative

Under the HST Alternative, an electrified train system would require delivery of a variable amount of electric power (a maximum per trainset on the order of 10 megawatts) at ± 25 kV of 60 Hz power by an overhead catenary system (OCS) extending the length of the right-of-way. The OCS would be powered from multiple supply substations located near the right-of-way and connected via high-voltage transmission lines to the statewide electric power grid. Two-phase power at ±25 kV would be carried on overhead transmission lines or in cables from supply substations to the OCS. In addition, substations at intermediate locations would serve switching and power boosting functions, although they would not be connected to the power grid. Control, monitoring, safety, and communications systems for railroad operations would use a fiber-optic cable system. Wireless communications would connect trainsets to the fiber-optic cable system. In addition, there would be a standard railroad block control system that would use a small current in the rails to sense train location.

Various components of the HST infrastructure and the trains themselves would be sources of both ELF and RF EMFs. Many of the ELF sources resemble the power lines, substations, and transmission lines used for the statewide electric power system, with the distinction that wayside power uses two electrical phases rather than the three phases that the California and national power systems use. Three-phase 60-Hz power would be supplied from high-voltage transmission lines connected to the power grid for conversion at substations to two-phase ±25-kV, 60-Hz power supplied to the OCS and trains. RF EMF, a principal source of EMI, is produced at the right-of-way by intermittent contact (unintentional arcing) between the pantograph power pickup and catenary wire. RF of this type is characterized by a band of frequencies ranging from kilohertz to megahertz. For transfer of data and voice communications from the fiber-optic trunk to trains in motion, narrow-band RF EMF would be radiated at low power from a lossy coaxial cable or similar antenna design located within the right-of-way. These RF EMFs would resemble, in frequency and field strength, the signals from short-range radio technologies such as walkie-talkies and cellular telephone handsets.

Figure 3.6-1 illustrates overall average magnetic field levels in five frequency bands for 14 transportation systems. Magnetic fields at 50 Hz in a French Train à Grande Vitesse (TGV) vehicle were averaged for measurements made at the head, ankle, and waist of passengers riding in several different vehicles and at several times. The overall 50-Hz magnetic field average was less than 0.5 μT (5 mG). This was several times less than for passengers on a conventional electrified train or electric shuttle bus, but several times greater than for passengers on ferry boats, non-electrified trains, escalators, and people-mover walkways. Localized magnetic fields in an HST vehicle can significantly exceed the overall average. Railroad EMFs decrease with distance from the right-of-way, substation, or power line and have negligible regional or statewide impact.

The HST system would traverse diverse geography and land uses in California with a diversity of potential EMF exposure in urban, suburban, rural, agricultural, and industrial regions. The populations potentially exposed to EMFs from the HST system include passengers, train crew, and other HST workers, as well as people in residences immediately adjacent to the distribution lines or rail line and at adjacent commercial, industrial, educational, medical care, military, and recreational facilities. Present understanding of health effects from long-term exposure to ELF magnetic fields is incomplete but shows that risks to the health of children and adults are either low or nonexistent. Effects of EMI may occur depending on distance to HST facilities and operating conditions. The variable nature of HST power consumption, which changes with

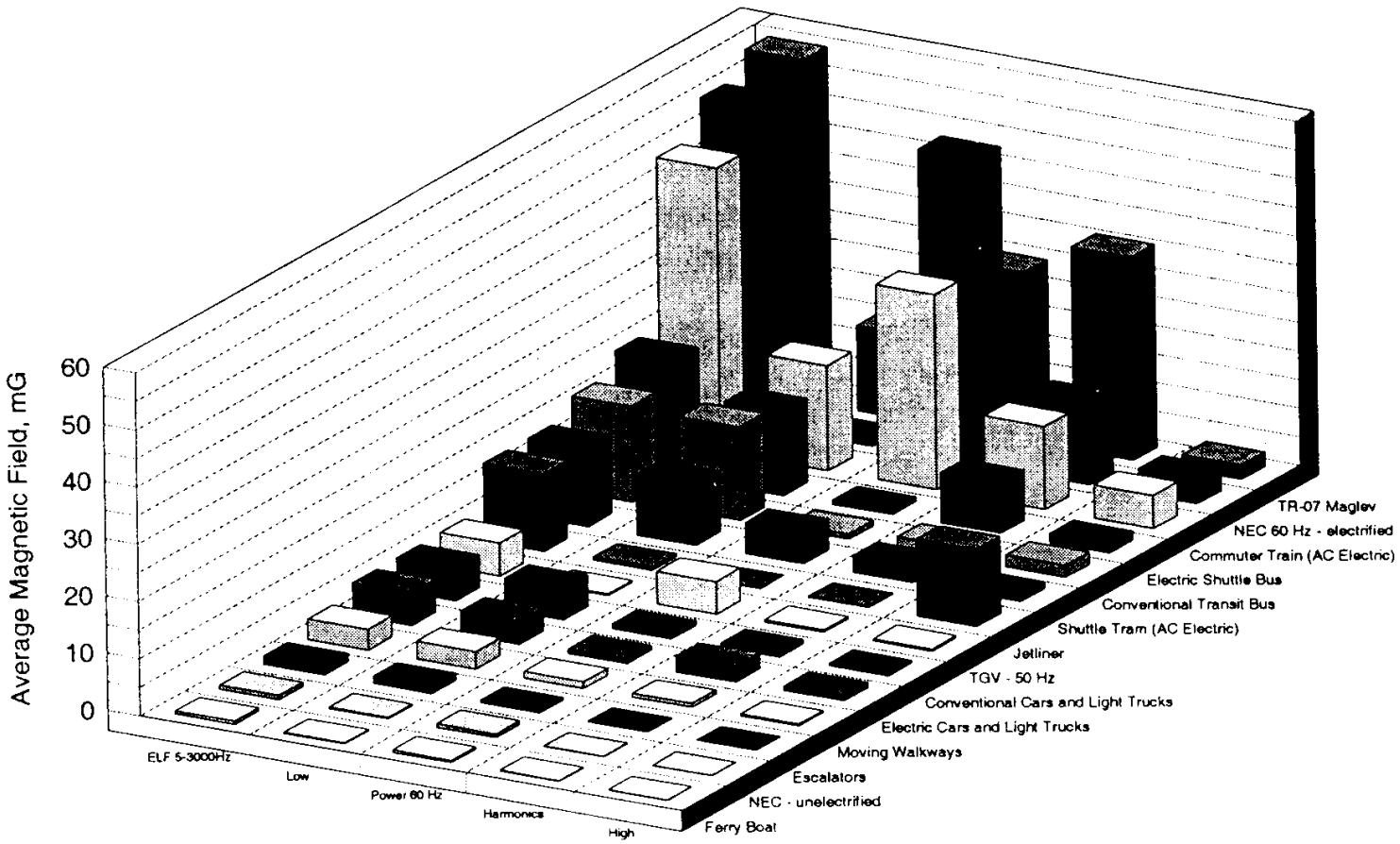


Figure 3.6-1. Magnetic Field Levels for 14 Transportation Systems

Dietrich and Jacobs, 1999

operational conditions that include the distance to a moving train, number of operational trains, and train acceleration and velocity, indicates that comparisons to less variable sources of ELF EMF fields may not be appropriate. There is little potential for strong ELF EMFs that can interfere with implanted biomedical devices (cardiac pacemakers, defibrillators, and infusion pumps) to be generated, with the possible exception of potential exposures of HST maintenance workers. For current data and designs, it is not likely that the MF inside an HST vehicle could interfere with even the most susceptible pacemaker. Overall, it can be expected that the HST Alternative would introduce additional EMF exposures or EMI at levels for which there are no established adverse impacts.

3.6.4 Design Practices

Standard design practices for overhead catenary power supply systems and vehicles include the use of appropriate materials, spacing, and shielding to avoid potential EMF/EMI impacts.

3.6.5 Mitigation Strategies and CEQA Significance Conclusions

ELF magnetic fields can best be mitigated by design features that reduce fields at the source, but shielding of large sources (bigger than a transformer in a building, or 4 to 8 cubic m) in affected environments would not be not practical. Careful design of the OCS, substations, and transmission lines could reduce ELF magnetic fields to a practical minimum.

Mitigation of ELF electric fields is sometimes possible by changes in the design of the source, and some shielding of a large source can be achieved by increasing vegetation. Relatively effective shielding of 60-Hz electric fields is afforded by ordinary building materials, and very good shielding is afforded by metal panels or screens.

EMI can be reduced at the project level through designs that minimize arcing and radiation of RF energy. Additional mitigation by shielding of sources is not practical, but susceptibility to EMI can be reduced by choosing RF devices designed for a high degree of electromagnetic compatibility. In some cases, electronic filters can be added to attenuate RF EMI. Relocation of receiving antennas and changes in antenna design to models with greater directional gain could mitigate EMI impacts, particularly for sensitive receptors near the HST system.

Based on the analysis above, and considering the CEQA Appendix G thresholds of significance for effects on human beings, it is expected that potential adverse effects from electromagnetic fields due to the proposed HST alternative could be avoided or mitigated to a less-than-significant level. Many of the design practices and mitigation strategies will be dependent on the project-level analysis and refinement of mitigation measures to address site-specific impacts. Specific structures and receptors evaluated at the project-level will influence the design of power supply systems and vehicles to shield and avoid EMF/EMI impacts, and mitigation measures refined from the mitigation strategies in this program EIR/S are expected to avoid or substantially lessen the impacts. Additional environmental assessment will allow more precise evaluation in the second-tier, project-level environmental analysis.

3.6.6 Subsequent Analysis

The following issues would be evaluated as part of the project-level analysis of an HST system.

- Proximity of occupied structures to high-voltage transmission lines serving supply stations.
- EMFs at passenger stations.
- EMFs in the vehicle compartment. This would require train design to take EMFs into account (e.g., seeking to limit them in the vehicle compartment to the extent practicable and feasible).

- EMFs at specific locations used by the train crew.
- Earth-return currents or power flows in circuits along the rails, where some fraction of the current finds its way back to substation or generating station through the earth for various regions and soil conditions, and the effects of different design and construction practices on these currents. The substations and generating stations would themselves be soundly connected to ground, allowing the earth currents to return there.
- Identification of specific structures (e.g., pipelines, cables, fences) that are particularly susceptible to induced ELF currents and methods for mitigation.
- Identification of receptors (e.g., telecommunications and research facilities) at specific locations with possibly greater sensitivity to EMI impacts.
- Spectral composition of RF generated by the pantograph-catenary contact under operational conditions.
- Technical features (e.g., frequency, field strengths, and modulation system) of the right-of-way-to-train wireless communications system.
- Consider development of an electromagnetic compatibility control plan (as described in APTA SS-E-010-98) to characterize EMI sources, reduction techniques, and susceptibility control procedures (shielding, surge protection, fail-safe circuit redesign, changed location of antennas or susceptible equipment, redesign of equipment, enclosures for equipment); include a safety analysis and failure analysis; and address grounding or shorting hazards.

3.7 LAND USE AND PLANNING, COMMUNITIES AND NEIGHBORHOODS, PROPERTY, AND ENVIRONMENTAL JUSTICE

This section evaluates the potential impacts of the No Project, Modal, and High-Speed Train (HST) Alternatives on land use compatibility, communities and neighborhoods, and property. This section also addresses environmental justice in accordance with the provisions of Executive Order (EO) 12898. This evaluation describes how existing conditions compare with the No Project Alternative and how the No Project Alternative compares with the potential impacts of the HST and Modal Alternatives, including a comparison among the HST alignment and station options within segments of the proposed HST system, in the five regions being studied.

3.7.1 Regulatory Requirements and Methods of Evaluation

A. REGULATORY PROVISIONS

Land Use, Communities and Neighborhoods, and Property

This section addresses the potential effects of each of the alternatives on existing and planned land uses. This section includes a discussion of the existing uses in and adjacent to areas where property acquisition may be needed for an alternative, an analysis of the changes to these uses which may occur with an alternative, a discussion of potential inconsistencies with land use plans, and identification of general mitigation strategies. The discussion of potential inconsistencies with planned land uses does not imply that the California High Speed Rail Authority (Authority), a state agency, would be subject to such plans or local ordinances, either directly or through the NEPA or CEQA process. The information is provided in order to indicate potential land use changes that could result in potential environmental impacts.

Environmental Justice

EO 12898, known as the federal environmental justice policy, requires federal agencies to address to the greatest extent practicable and permitted by law the disproportionately high adverse human health and environmental effects of their programs, policies, and activities, on minority populations and low-income populations in the United States. Federal agency responsibilities under this EO also apply to Native American programs. Department of Transportation (DOT) Order 5610.2 on environmental justice defines "disproportionately high and adverse effect on minority and low-income populations" to mean an adverse effect that is predominately borne by a minority population and/or a low-income population, or will be suffered by the minority population and/or low-income population and is appreciably more severe or greater in magnitude than the adverse effect that will be suffered by the non-minority population and/or non-low-income population (Department of Transportation Order 5610.2, Appendix Definitions, subd.[g]).

The California Government Code defines environmental justice as the "fair treatment of people of all races, cultures, and incomes with respect to the development, adoption, implementation, and enforcement of environmental laws, regulations, and policies" (California Government Code § 65040.12[e]). There are no specific state procedures prescribed for consideration of environmental justice issues related to the proposed HST system.

B. METHODS OF EVALUATION OF IMPACTS

The analysis was conducted using existing U.S. Census 2000 tract information/data compiled in a geographic information systems (GIS) format, local community general plans or regional plans, and land use information provided by the planning agencies in each of the regions. Existing and future conditions were described for the No Project Alternative by documenting existing information for existing and planned future land use policy in potential alignment, potential station and existing

airport areas, development patterns for employment and population growth, demographics, communities and neighborhoods, housing, and economics. The No Project Alternative was compared to the planned uses reflected in general plans and regional plans to see if it may result in potential effects on future development. The general and regional plans consulted for this section are listed in Chapter 12, *Sources Used in Document Preparation*.

The ranking systems described below were used to evaluate potential impacts for all three alternatives for land use changes, land use compatibility, and property. Potential impacts on communities and neighborhoods were also considered. The presence of minority populations and low-income populations in the study area for the alternatives was identified in order to consider potential environmental justice issues. Because this is a programmatic environmental review, the analysis of these potential impacts was performed on a broad scale to permit a comparison of relative differences among the alternatives. Further evaluation of potential impacts would occur at the project-level environmental review, should a decision be made to proceed with the proposed HST system.

Land Use Compatibility

The potential compatibility of the alternatives with existing land use is evaluated based on the potential sensitivity of various land uses to the changes which would be included with the Modal and HST Alternatives, and the potential impact of these changes on existing and planned land uses. For example, homes and schools are more sensitive to changes that may result in increased noise and vibration (see Section 3.4, *Noise and Vibration)* or increased levels of traffic congestion (see Section 3.1, *Traffic and Circulation).* Industrial uses, however, are typically less sensitive to these types of changes because they interfere less with normal industrial activities. Since in this analysis an area's sensitivity or compatibility is based on the presence of residential properties, low, medium, and high levels of potential compatibility are identified based on the percentage of residential area affected, the proximity of the residential area to facilities included in the Modal or HST Alternatives, and the presence of local or regional uses (such as parks, schools, and employment centers.). For highway corridors (under the No Project and Modal Alternatives) and for proposed HST alignments, land use compatibility was assessed using GIS layers (or aerial photographs where available) to identify proximity to housing and population, and to determine whether the alignments would be within or outside an existing right-of-way in the study area. Potential impacts are considered low if existing land uses within a potential alignment, station, airport expansion area, or maintenance facility area are found to be compatible with the land use changes that may result from either the Modal or HST Alternative. The type of improvement that would be associated with either the Modal or HST Alternative would also affect the level of potential impact. Improvements such as potential widening of an existing right-of-way or the need for new right-of-way were considered to have a low compatibility with agricultural land. Conversely, if the improvement would be contained within the existing right-of-way or within a tunnel, the alternative was considered to be compatible with agricultural land.

Future land use compatibility is based on information from general plans and other regional and local transportation planning documents. These documents were examined to assess an alternative's potential consistency with the goals and objectives defined therein. The Modal Alternative is considered compatible if the highway or airport improvement is in the regional transportation plan (RTP) or regional airport master plan. The HST Alternative is considered highly compatible if it would be located in areas planned for transportation multi-modal centers or corridor development, redevelopment, economic revitalization, transit-oriented development, or high-intensity employment. Compatibility would be considered low if an alternative would be potentially inconsistent with local or regional planning documents. Table 3.7-1 summarizes the potential compatibility rating of existing and planned land use types with the alternatives, including potential HST alignment and station options. Thus, where potential compatibility would

be rated low, the potential for impacts would be higher, and where potential compatibility would be rated high, the potential for impacts would be lower.

Table 3.7-1
Compatibility of Land Use Types

Low Compatibility	Medium Compatibility	High Compatibility
Single-family residential, neighborhood park, habitat conservation area, elementary/middle school, agricultural (widened or new right-of-way needed)	Multifamily residential, high schools, community parks, low-intensity industrial, hospitals	Business park/regional commercial, multifamily residential, existing or planned transit center, high intensity industrial park, service commercial, commercial recreation, college, transportation/utilities, high-intensity government facilities, airport or train station, agricultural (tunnel or no new right-of-way needed)

Communities and Neighborhoods

A potential impact on a community or neighborhood was identified if an alternative would create a new physical barrier, isolating one part of an established community from another and potentially resulting in a physical disruption to community cohesion. Improvements to existing transportation corridors, including grade separations, would not generally result in new barriers.

Property

Assessment of potential property impacts is based on the types of land uses adjacent to the particular proposed alignment, the amount of right-of-way potentially needed due to the construction type, and the land use sensitivity to potential impacts. Impacts include potential acquisition, displacement and relocation of existing uses, or demolition of properties.

In some instances, relatively minor strips of property would be needed for temporary construction easements or permanent right-of-way for the proposed HST alignments or highway expansions. In other instances, implementation of proposed facilities may result in acquisition, displacement, and/or relocation of existing structures. The types of property impacts that may occur include displacement of a residence or business or division of a farm or other land use in a way that makes it harder to use. Mitigation may also be required to maintain property access. Potential property impacts were ranked high, medium, or low as summarized below in Table 3.7-2.

Table 3.7-2
Rankings of Potential Property Impacts

	Type of Development						
	Residential			Non-residential			
Facility Requirements	Rural/ Suburban	Suburban/ Urban	Urban	Rural Developed	Suburban Industrial/ Commercial	Urban Business Parks/ Regional Commercial	Rural Non-developed
No additional right-of-way needed (also applies to tunnel segments for HST Alternative)	Low	Low	Low	Low	Low	Low	Low
Widening of existing right-of-way required	Medium	Medium	High	Low	Medium	High	Low
New corridor (new right-of-way required; includes aerial and at-grade arrangements)	High	High	High	Medium	Medium	High	Low to medium

To determine potential property impacts, the land uses within 50 feet (ft) (15 meters [m]) of either side of the existing corridor, or within 50 ft (15 m) of both sides of the centerline for new HST alignments, were characterized by type and density of development. Densities of structures, buildings, and other elements of the built environment are generally higher in urbanized areas. *Rural/suburban* residential refers to low-density, single-family homes. *Suburban/urban* is medium density, multifamily housing such as townhouses, duplexes, and mobile homes. *Urban residential* refers to high-density multifamily housing such as apartment buildings. *Rural developed* non-residential uses typically occur in non-urbanized areas and often include developed agricultural land such as vineyards and orchards. *Suburban industrial/commercial* refers to medium density non-residential uses and includes some industrial uses, as well as transportation, utilities, and communication facilities. *Urban business parks/regional commercial* refers to non-residential uses that occur in urbanized areas and includes such uses as business parks, regional commercial facilities, and other mixed use/built-up uses. *Non-rural undeveloped land* includes cropland, pasture, rangeland, and few structures. The classification of development types was based on land use information provided by the planning agencies in each of the regions.

Environmental Justice

This analysis is based on identifying the presence of minority populations and low-income populations in the study area (0.25 mi [0.40 km] from a potential alignment), and generally in the counties crossed by the alignments included in the alternatives. This assessment was done using U.S. Census 2000 information and alignment information to determine if minority or low-income populations exist within the study areas and if they do, whether the alignments would be within or adjacent to an existing transportation right-of-way (lower potential for impacts) or new alignments (higher potential for impacts).

Based on the above information, the analysis determined the following.

- Whether at least 50% of the population in the study area may be minority or low-income.
- Whether the percentage of minority or low-income population in the study area may be at least 10% greater than the average generally in the county or community.

The assessment of potential for impacts on minority and low-income populations considered the size and type of right-of-way needed for the alternatives. For example, if an alignment were within an existing right-of-way, the potential for impacts would be lower. If the alignment would be on new right-of-way, then the potential for impacts may be higher. The potential alignments, however, have been identified and described to largely use or be adjacent to existing transportation rights-of-way in order to avoid or reduce potential impacts on natural resources and existing communities to the extent feasible and practicable (see Chapter 2, *Alternatives*). Since this is a program-level document, the analysis considers the alternatives on a broad scale, including the proposed HST system as a whole. It is not expected that the proposed HST system as a whole would result in disproportionate impacts on minority or low-income populations. Additional analysis would take place during project-level analysis to consider potential localized impacts.

3.7.2 Affected Environment

A. STUDY AREA DEFINED

The study area for land use compatibility, communities and neighborhoods, and environmental justice, is 0.25 mi (0.40 km) on either side of the centerline of the rail and highway corridors included in the alternatives, and the same distance around stations, airports, and other potential HST-related facilities. This is the extent of area where either the Modal or HST Alternative might result in changes to land use; the type, density, and patterns of development; and socioeconomic conditions. For the property impacts analysis the study area is narrower—100 ft (30 m) on either side of the alignment centerlines—to better represent the properties most likely to be impacted by the improvements included in the alternatives (e.g., potential highway widenings or potential HST lines).

The planned land use for all regions is generally described by city and county general plans that encompass the alignments for the HST and Modal Alternatives. Several regulatory agencies and special districts also have future development plans that are considered in this analysis for lands these alternatives would cross. Communities have typically recognized and incorporated the existing rail and highway corridors in their general land use plans, and most communities encourage transit-oriented development and transit facilities to relieve highway congestion and improve mobility.

Other resources such as U.S. Census 2000 data, California Department of Finance data, aerial photos, and field observations were used to document existing and future (Year 2020) conditions for demographics, communities, and neighborhoods.

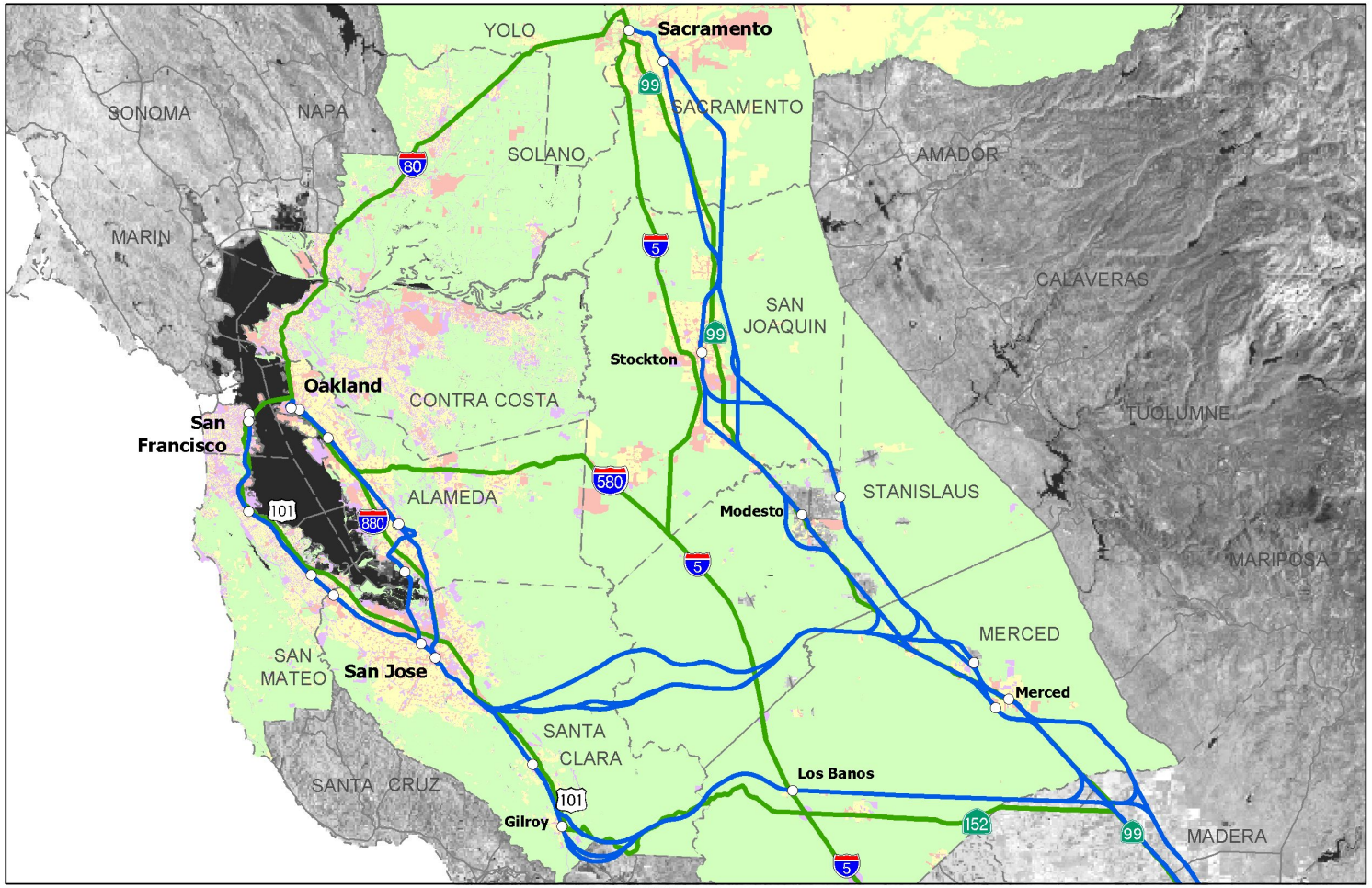
Figures 3.7-1 through 3.7-4 show the general land uses existing in each region.

B. DISCUSSION OF RESOURCES BY REGION

This section briefly describes the five regions the project would potentially traverse and briefly discusses the land use-related resources in the regions under the following five categories: existing and planned land use, population characteristics, income, neighborhood and community characteristics, and housing.

For this discussion, land use data came from local governments and regional agencies such as metropolitan planning organizations. The source of demographic information (existing population

Figure 3.7-1
Existing Land Use Bay Area to Merced, and Sacramento



Source: Various Cities, Counties, and Planning Organizations

July 14, 2003

California High Speed Train Program EIR/EIS

5 0 5 10 15 20 Miles

5 0 5 10 15 20 Kilometers

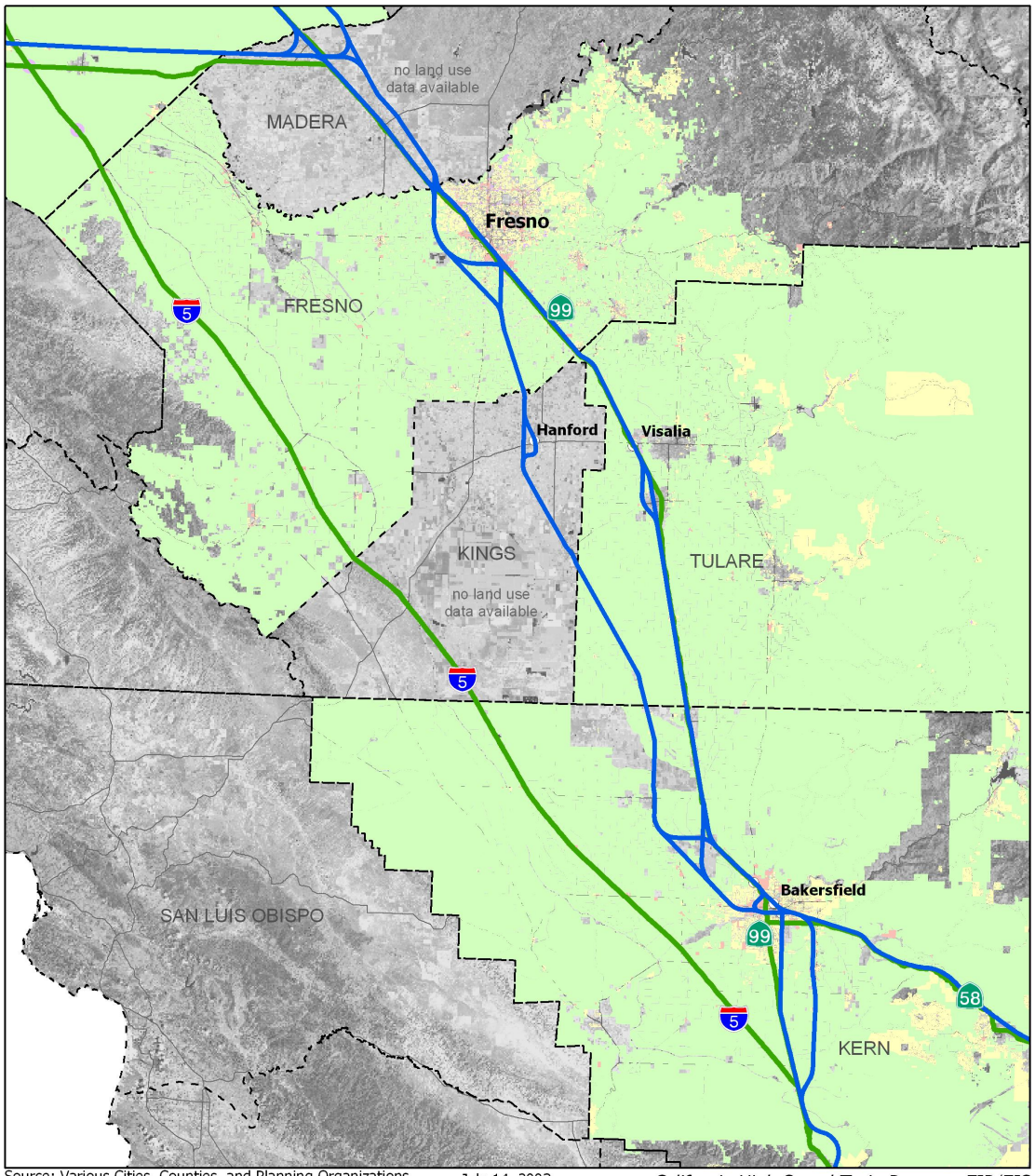
CALIFORNIA HIGH SPEED RAIL AUTHORITY

Legend

- Residential
- Commercial/Industrial
- Other Urban Built-Up
- Agricultural/Open Space
- High Speed Train Alignment and Stations
- Modal (Highway) Alignment

Land Use
Bay Area/Sacramento to Merced

Figure 3.7-2
Existing Land Use Merced to Bakersfield



Source: Various Cities, Counties, and Planning Organizations

July 14, 2003

California High Speed Train Program EIR/EIS

Legend

- Residential
- Commercial/Industrial
- Other Urban Built-Up
- Agricultural/Open Space
- High Speed Train Alignment and Stations
- Modal (Highway) Alignment

10 5 0 10 20 Miles

10 5 0 10 20 Kilometers

CALIFORNIA HIGH SPEED RAIL AUTHORITY

Land Use
Merced to Bakersfield

Figure 3.7-3
Existing Land Use Bakersfield to Los Angeles

Source: Various Cities, Counties, and Planning Organizations July 21, 2003

California High Speed Train Program EIR/EIS

Legend

- Residential
- Commercial/Industrial
- Other Urban Built-Up
- Agricultural/Open Space
- High Speed Train Alignment and Stations
- Modal (Highway) Alignment

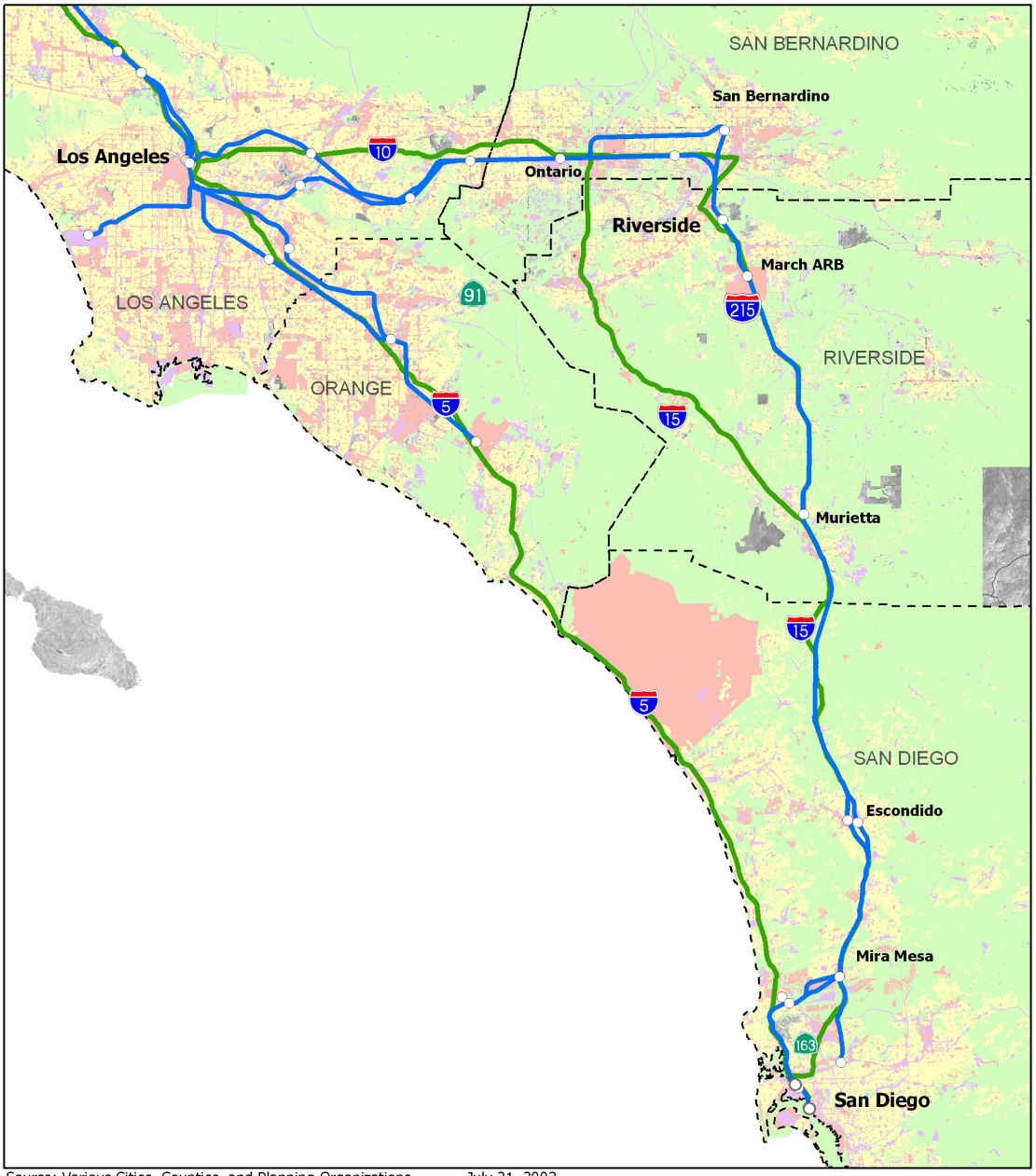
5 0 5 10 15 Miles

5 0 5 10 15 Kilometers

CALIFORNIA HIGH SPEED RAIL AUTHORITY

Land Use
Bakersfield to Los Angeles

Figure 3.7-4
Existing Land Use Los Angeles to San Diego (via Inland Empire and Orange County)



Source: Various Cities, Counties, and Planning Organizations July 21, 2003

California High Speed Train Program EIR/EIS

Legend

- Residential
- Commercial/Industrial
- Other Urban Built-Up
- Agricultural/Open Space
- High Speed Train Alignment and Stations
- Modal (Highway) Alignment

5 0 Miles

5 0 5 10 15 Kilometers

CALIFORNIA HIGH SPEED RAIL AUTHORITY

Land Use
Los Angeles to San Diego

and projects, ethnicity, income, and housing) was primarily the California Department of Finance and U.S. Census 2000. This data, as well as existing and planned land use information, were compiled in a GIS format.

Bay Area to Merced

This region includes the San Francisco Bay Area (San Francisco and Oakland) south to the Santa Clara Valley and east across the Diablo Range to the Central Valley.

Existing Land Use: For most of the northern part of the region, the highway (US-101, I-80, I-880, and SR-152) and rail corridors that the Modal and HST Alternatives would use are existing transportation corridors surrounded by the built-up urban areas that they serve. Adjacent land uses are a mix of residential, industrial, commercial, and other urban uses. Industrial uses are concentrated around San Francisco International Airport (SFO) off US-101, Norman Y. Mineta San Jose International Airport (SJC), and Oakland International Airport (OAK). SFO and OAK are adjacent to San Francisco Bay. Commercial and residential uses are located to the southwest of SJC. The Don Edwards San Francisco Bay National Wildlife Refuge lies on the east side of the Bay, as discussed in Section 3.15, *Biological Resources and Wetlands*. The southern part of the US-101 corridor in this region includes some agricultural uses and rangeland. The segment of SR-152 between US-101 and I-5 passes through the Diablo Mountain Range and continues through Pacheco State Park, Cottonwood Creek Wildlife Area, and other open space, wildlife, and recreational areas. Agriculture and rangeland uses are prevalent east of I-5. Proposed HST alignment options would pass through the Diablo Mountain Range north of or through Henry Coe State Park and north of the Andersen Reservoir. HST options that are proposed farther south would pass through or by Gilroy through primarily agricultural lands.

Population Characteristics: The Bay Area to Merced region includes 13 counties: Madera, Merced, San Benito, Stanislaus, Santa Clara, Alameda, San Mateo, San Francisco, Contra Costa, Solano, Yolo, Sacramento, and San Joaquin. Population in this region grew from 7.6 million people in 1990 to 8.7 million in 2000, an increase of 14%. By 2020, population in the region is expected to reach 10.8 million, an increase of 23% over 2000 levels. According to U.S. Census 2000, minority persons, defined as non-white persons including persons of Hispanic origin, accounted for the following percentages of total population in the counties in the region (lowest to highest): Yolo 42%, Sacramento 42%, Contra Costa 42%, Stanislaus 43%, San Mateo 50%, Solano 51%, San Joaquin 53%, Santa Clara 53%, Madera 53%, San Benito 54%, San Francisco 58%, Alameda 59%, and Merced 60%.

Income: According to U.S. Census 2000, the average federal poverty threshold for a family of four with two children under the age of 18 is an annual income of $17,603. The percentages per county of households identified as below federal poverty level in this region are (lowest to highest) San Mateo 6%, Santa Clara 8%, Contra Costa 8%, Solano 8%, San Benito 10%, Alameda 11%, San Francisco 11%, Sacramento 14%, Stanislaus 16%, Yolo 18%, San Joaquin 18%, Madera 21%, and Merced 22%.

Neighborhood and Community Characteristics: The portion of the region along the San Francisco Bay and southward into Santa Clara County is generally highly urbanized, and is characterized by a mix of residential communities, commercial, industrial, and public/institutional land uses. As the region continues south and east into the Central Valley, it includes undeveloped and agricultural areas, interspersed with suburban communities.

Sacramento to Bakersfield

This region of central California includes a large portion of the Central Valley (San Joaquin Valley) from Sacramento south to Bakersfield.

Existing Land Use: The existing land uses along the potential routes of the Modal and HST Alternatives in this region are predominantly agricultural, reflecting the Central Valley's heritage as one of the richest, most productive agricultural regions in the world (as discussed in Section 3.8, *Agricultural Lands)*. Much of the land in the vicinity of the highway and rail corridors in the region proposed for improvements is cropland and orchards. Residential development comprises less than 10% of the land area, and commercial, service, and industrial uses together account for less than 10%. Development is focused in and around existing cities and towns where residential, commercial, and industrial uses are concentrated. Beyond city limits, land uses are predominantly agricultural, with scattered rural residences, small towns, and warehouse-style industrial development along the rail and highway corridors included in the Modal and HST Alternatives. Between Sacramento and Stockton, the easterly Central California Traction Company (CCT) alignment traverses more rural lands than the Union Pacific Railroad (UPRR). While much of the area between Stockton and Modesto is agricultural in nature, there are large residential tracts and smaller commercial areas along UPRR and, to a lesser extent, along the Burlington Northern Santa Fe (BNSF) alignment. South of Modesto to Merced, land uses are predominantly agricultural along the HST route that would follow BNSF. Near Merced Airport, a variety of government uses, many ranchettes, and rural residential or agricultural uses are located.

South of the City of Merced, the land uses mirror the predominant land use in this area of the valley: fragmented agricultural lands scattered with residences and a few small towns. As the UPRR rail alignment approaches the Fresno urban core, residential uses dominate the landscape to the east, and a mix of light industrial, heavy commercial, and open space line the stretch on the western side. Beyond industrial uses on the south side of Fresno, development becomes sparser, giving way to scattered rural residences and agricultural uses. Continuing into Tulare County, the various routes proposed for the Modal and HST Alternatives would pass farmlands and the Colonel Allensworth State Historic Park. South of this park all the way into Bakersfield, agriculture is the predominant land use, the only exception being small towns. Approaching Bakersfield, the rail alignments continue into the dense urban environment. At Bakersfield Airport, light industrial and heavy commercial uses line SR-99, with agricultural uses to the west.

Population Characteristics: The Sacramento to Bakersfield region includes nine counties: Sacramento, San Joaquin, Stanislaus, Merced, Madera, Fresno, Tulare, Kings, and Kern. In 2000, there were 4.6 million people living in this region. By 2020, the population is expected to increase by 46% to 6.7 million.

Throughout most of the region, the percentage of whites and Hispanics in the overall population by county is comparable (Fresno: whites 40%, Hispanics 44%; Kings: whites 42%, Hispanics 44%; Madera: whites 47%, Hispanics 44%; Merced: whites 41%, Hispanics 45%; and Tulare: whites 42%, Hispanics 51%). Counties that have non-agricultural industries or are within commuting range of the San Francisco Bay Area tend to have larger percentages of whites (e.g., Sacramento: whites 58%, Hispanics 16%; San Joaquin: whites 47%, Hispanics 31%; Stanislaus: whites 57%, Hispanics 32%; and Kern: whites 49%, Hispanics 38%).

Income: Per-capita income tends to be lower in communities that rely chiefly on an agricultural employment base. For example, Kings County, with a population of 129,500 in 2000, had a workforce of 45,880 people, 14% of which were unemployed, and an average per-capita income of $15,492. Counties that have a more diversified economy (including industries such as oil, healthcare, and technology), such as Kern and Sacramento Counties, tend to support larger workforces at higher average incomes. Sacramento County, with a population of 1.2 million in 2000, had a workforce of 605,500 people, only 4% of which were unemployed, and an average per-capita income of $26,257.

The percentage per county of households identified as below federal poverty level (less than $17,603 annually) in the Sacramento to Bakersfield region is (lowest to highest) Sacramento 14%, San Joaquin 18%, Stanislaus 16%, Kings 20%, Kern 21%, Merced 22%, Madera 21%, Fresno 23%, Tulare 24%.

Neighborhood and Community Characteristics: There are a number of established neighborhoods within the cities along the highways and roadways included as potentially feasible for modification under the Modal Alternative, and along the rail corridors proposed for HST Alternative alignments. There are also a number of older agricultural communities in the unincorporated portions of the counties.

Bakersfield to Los Angeles

This region of southern California encompasses the southern portion of the Central Valley south of Bakersfield, the mountainous areas between the Central Valley and the Los Angeles basin, and the northern portion of the Los Angeles basin from Sylmar to downtown Los Angeles.

Existing Land Use: Along SR-99 and I-5, the corridors relevant to the Modal and HST Alternatives, this region consists of three distinct sub-regions: north, central, and south. The northern portion of the region—from Bakersfield south to the northern base of the mountains—is largely agricultural until it enters the suburban mix of land uses in southern Bakersfield. The central portion of the region crosses the mountains and is characterized by rugged and largely undeveloped land. Much of this area is in national forest, and some is rangeland. A portion of the central segment passes through the high desert suburban communities of Palmdale and Lancaster. In the Santa Clarita area, some areas abutting proposed Modal and HST Alternative alignments are designated significant ecological areas (as described in Section 3.15, *Biological Resources and Wetlands).* The southern portion, extending from Sylmar to Los Angeles Union Station (LAUS), is an older, highly urbanized area characterized by a mix of residential, commercial, industrial, and public/institutional land uses. Burbank-Glendale-Pasadena Airport is located within this urban context.

Population Characteristics: The Bakersfield to Los Angeles region includes two counties: Kern and Los Angeles. Total population in the region increased from 9.4 million in 1990 to 10.2 million in 2000, an average annual growth of 0.8%. Population in Kern County increased by 118,000 people over that period, but the majority of the growth occurred in Los Angeles County, where population increased by 656,000 people between 1990 and 2000. Total population in the region is expected to increase to 12.7 million between 2000 and 2020, a 1% average annual growth rate. Los Angeles County is expected to contribute the majority (92%) to the forecast increase.

Minority persons, defined as non-white persons, accounted for 51% of Los Angeles County's population in 2000. Minorities accounted for 38% of the population in Kern County. The Hispanic population percentage in Los Angeles County is 45%; it is 38% in Kern County.

Income: Income in the region was $20,363 per capita in 1999, and 18% of the population had incomes below the federal poverty level ($17,603). In Kern County, per-capita income was $15,760, with 21% of the population below the federal poverty level. In Los Angeles County, per-capita income was $20,683, with 18% of the population below the federal poverty level.

Neighborhood and Community Characteristics: As noted above, the Bakersfield to Los Angeles study area consists of three distinct sub-regions: northern, central, and southern. The northern portion, extending from the northern toe of the mountains to Bakersfield, is largely agricultural until it enters the suburban mix of land uses in southern Bakersfield. The central portion crosses the mountains and is characterized by rugged and largely undeveloped land. Much of this area is

in national forest. A portion of the central segment passes through the high desert suburban communities of Palmdale and Lancaster. The southern portion, extending from LAUS to Sylmar, is an older, highly urbanized area characterized by a mix of residential, commercial, industrial, and public/institutional land uses.

Los Angeles to San Diego via Inland Empire

This region of southern California includes the eastern portion of the Los Angeles basin from downtown Los Angeles east to the Riverside and San Bernardino areas and south to San Diego generally along the I-215 and I-15 corridors.

Existing Land Use: Existing land use in the LAUS to March Air Reserve Base (ARB) section of the study area in the region is largely developed. The major land use in this area is low-density residential. Combined residential uses comprise nearly 35% of the area adjacent to I-10, while industrial uses predominate along the railroad alignments under consideration for HST alignment options. Transportation and utility uses are present in or adjacent to both rail and freeway rights-of-way. Undeveloped land and commercial uses are also present. The majority of the surrounding land use is low-density residential in the proposed HST segment that would loop through San Bernardino. Industrial uses and undeveloped land comprise the next highest concentration.

Half of the segment between March ARB to Mira Mesa lies in Riverside County, and the other half is in the San Diego Association of Governments (SANDAG) planning area. Undeveloped land is the largest land use in the Riverside County portion of this segment, with agricultural use second. Within the southern section, undeveloped land also makes up the largest portion. Residential uses comprise the next highest land use, followed by agricultural uses. Transportation and utility uses define the land dedicated to the I-15 and I-215 corridors. The variety of land uses along the corridor between Mira Mesa and San Diego reflects the generally suburban nature of northern San Diego and the urban character of the city. Other than transportation-related uses, parks, undeveloped land, commercial, office, and military uses comprise the largest areas. Light industry and institutional uses are found along the proposed Miramar Road HST segment.

Population Characteristics: This region includes four counties: Los Angeles, San Bernardino, Riverside, and San Diego. The population of the region increased by 12% between 1990 and 2000, from 13.9 million people to 15.5 million. By 2020, population in this region is forecast to reach 20.4 million, a 31% increase.

Minority persons accounted for 51% of Los Angeles County in 2000, 35% of Riverside County, 41% of San Bernardino County, and 34% of San Diego County. Hispanic population accounted for 45% of Los Angeles County in 2000, 36% of Riverside County, 39% of San Bernardino County, and 27% of San Diego County.

Income: In Los Angeles County, per-capita income was $20,683, with 18% of the population below the federal poverty level ($17,603). In Riverside County, per-capita income was $18,689, with 14% of the population below the federal poverty level. San Bernardino County had a per-capita income of $16,865, with 16% of the population below the federal poverty level. San Diego County's per-capita income was $22,926, with 12% of the population below the federal poverty level.

Neighborhood and Community Characteristics: The Los Angeles to San Diego via Inland Empire region consists of the older, urbanized areas of central and eastern Los Angeles County, the more recently urbanized portions of western San Bernardino and Riverside counties, the urbanizing areas of central and southwest Riverside County, the urbanizing areas of northwestern San Diego County, and the urbanized portions of the city of San Diego.

Los Angeles to San Diego via Orange County
This region includes the western portion of the Los Angeles basin between downtown Los Angeles and LAX, and the coastal area of southern California between Los Angeles and San Diego, generally following the existing Los Angeles to San Diego via Orange County I-5 highway corridor.

Existing Land Use: This region is largely urbanized, with the exception of the Camp Pendleton military base between San Clemente and Oceanside. The major existing land uses in the study area in this region include single-family residential, commercial and industrial, transportation and utilities, and community parks.

Population Characteristics: This region includes three counties: Los Angeles, Orange, and San Diego. The region's population increased by 10% between 1990 and 2000, from 13.8 million persons to 15.2 million. By 2020, population in this region is forecast to reach 18.6 million, an increase of 23%.

Minority persons accounted for 51% of Los Angeles County in 2000, 35% of Orange County, and 34% of San Diego County. The Hispanic population is 45% in Los Angeles County, 31% in Orange County, and 27% in San Diego County.

Income: In Los Angeles County, per-capita income was $20,683, with 18% of the population below the federal poverty level ($17,603). Per-capita income in Orange County was $25,826, with 10% of the population below the federal poverty level. San Diego County had a per-capita income of $22,926, with 12% of the population below the federal poverty level.

Neighborhood and Community Characteristics: The proposed Modal and HST Alternative (HST and conventional rail) corridors would all pass through communities with similar characteristics. The corridors would cross the metropolitan area of Los Angeles, south Orange County, and the metropolitan area of San Diego. Communities in these areas have both common and unique characteristics shaped by a variety of political, physical, social, and economic factors. The Los Angeles metropolitan area can be characterized as a highly urbanized mix of single- and multifamily neighborhoods, with commercial and industrial development in such communities as Los Angeles, Norwalk, Fullerton, and Anaheim. The area is strongly influenced by the existing transportation network. The south Orange County area can be characterized as smaller communities with strong ties to the coastline. The communities comprise predominantly single-family neighborhoods with supporting commercial and industrial development. Communities such as San Juan Capistrano, Dana Point, and San Clemente represent this area. The San Diego metropolitan area can be characterized as a highly dense urban area rimmed by lower density suburban and coastal communities that have close interaction with coastal resources. Communities that represent this area are Oceanside, Carlsbad, Encinitas, Solana Beach, and Del Mar.

3.7.3 Environmental Consequences

A. EXISTING CONDITIONS COMPARED TO NO PROJECT ALTERNATIVE

Land use and local communities will change between 2003 and 2020 as a result of population growth and changes of economic activity in the five regions studied (see Chapter 5, *Economic Growth and Related Impacts).* The No Project Alternative is based on existing conditions and the funded and programmed transportation improvements that will be developed and in operation by 2020. Although it is expected that the No Project Alternative would result in some changes related to land use compatibility, communities and neighborhoods, property, and environmental justice, it was assumed that projects included in the No Project Alternative would include typical design and construction practices to avoid or minimize potential impacts, and would be subject to a project-level

environmental review process to identify potentially significant impacts and to include feasible mitigation measures to avoid or substantially reduce potential impacts. Although some changes would be likely, attempting to estimate such changes would be speculative. Therefore, no additional potential impacts were quantified for the No Project Alternative.

B. NO PROJECT ALTERNATIVE COMPARED TO MODAL AND HIGH-SPEED TRAIN ALTERNATIVES

Land Use Compatibility

The Modal Alternative would be potentially incompatible with existing and planned land use in some segments to a greater extent than the No Project and HST Alternatives, because it would not be consistent with policies that support increased transit alternatives and reduced dependency on the automobile. The highway improvement options would support a dispersed pattern of development and would be inconsistent with local and regional planning objectives that promote transit-oriented higher-density development around transit nodes in order to encourage and increase planned in-fill for more efficient use of land and resources and sustainable growth.

The HST Alternative would include many potential new station locations, which were identified through consultation with local planning agencies and selected to be compatible to the extent possible with future planned land uses. Overall, the proposed HST Alternative would be highly compatible with local and regional plans that support rail systems and transit-oriented development. The HST Alternative would also provide improved inter-modal connectivity with existing local and commuter transit systems.

Communities and Neighborhoods

Similar to the No Project Alternative, the Modal Alternative would generally follow existing transportation corridors and rights-of-way, would not be expected to create new barriers within neighborhoods, and would not be expected to result in potential impacts on community cohesion. Though much of the HST Alternative would follow existing or planned transportation corridors, several alignment options would represent new transportation corridors. Along some of the potential alignments in all regions except the Los Angeles to San Diego via Orange County corridor, there would be potential for localized impacts on community cohesion, which would receive further study during project-level review, if a decision is made to proceed with the proposed HST system, and depending upon the alignments selected in the future.

Property

In the Bay Area to Merced and Los Angeles to San Diego via Orange County regions, potential right-of-way acquisition associated with transportation improvements under the No Project Alternative, such as the expansion of existing facilities and the construction of new facilities, could result in property impacts, which would be addressed in future project-specific environmental analyses prior to the implementation of these improvements. In the Sacramento to Bakersfield, Bakersfield to Los Angeles, and Los Angeles to San Diego via Inland Empire regions, the No Project Alternative is not anticipated to have substantial property impact potential. The No Project Alternative, which includes currently programmed and funded improvements and the mitigation for impacts that would be provided with these improvements as a result of environmental reviews, is the basis for analyzing the potential Modal and HST Alternatives.

Potential property impacts in addition to those under the No Project alternative would be expected to be substantially greater under the Modal Alternative than under the HST Alternative. In urban areas, highways are generally more constrained by denser development (which would have a higher potential for impacts, including residential uses) than railways. Therefore, highway expansion would have greater potential for impacts on land uses than rail expansion. Highways

in urban areas also generally use most, if not all, of their existing right-of-way and would require additional right-of-way for expansion. Under the Modal Alternative, 309 mi (497 km) of highway alignment (20% of total Modal Alternative highway alignment in the region) would potentially affect high-impact land uses, and 289 mi (465 km) of alignment (19% of total Modal Alternative highway alignment) would affect medium-impact land uses.

Under the HST Alternative, between 53 mi (85 km) and 88 mi (142 km) of rail alignment and station locations (between 7% and 11% of total alignment distance) would potentially affect high-impact land uses, and between 92 mi (148 km) and 145 mi (233 km) of track alignment and station locations (between 11% and 17% of alignment distance) would potentially affect medium-impact land uses. Commercial and industrial uses are typically located along railways, and these uses buffer residential development from the railroad. Also, in several of the rail corridors under consideration, rail activity could be expanded within the existing right-of-way and would not require additional right-of-way.

Therefore, the HST Alternative would have less potential to affect high-impact land uses than the Modal Alternative. The Modal Alternative would potentially result in more than three times the mileage of high impacts on land uses than the HST Alternative. This potential for more property acquisition and residential and non-residential relocation, and the costs associated with these activities, represents a significant difference between the Modal and HST Alternatives.

Environmental Justice

Many of the alignments included in the Modal and HST Alternatives would be located in existing transportation corridors, which would serve to reduce potential for significant adverse environmental impacts generally. This broad-scale analysis considers the wide variety of landscape types and land uses, both low-density rural areas and developed communities, which would be adjacent to either the Modal Alternative (which would include nearly 3,000 additional highway lane miles [4,828 km] and certain airport expansions) or the HST Alternative (which includes more than 700 mi [1,127 km] of potential alignment and station options). Considering the alternatives on a system-wide basis, it is not expected that either the Modal or HST Alternatives would result in disproportionate impacts on minority populations or low-income populations. In addition, along with the potential environmental impacts analyzed in this Program EIR/EIS, general mitigation strategies are assessed which would be expected to be used to reduce potential impacts, if a decision were made in the future to proceed with the proposed HST system. If a decision were made to go forward with the proposed HST system, project-level review would include more detailed analysis of any potentially significant environmental impacts and mitigation measures to reduce such impacts. Project-level review would include additional consideration of potential localized impacts on neighborhoods and communities, in addition to potential community enhancements and benefits from the proposed HST system.

3.7.4 Comparison of Alternatives by Region

A. BAY AREA TO MERCED

Land Use Compatibility

Modal Alternative: All of the highway improvement options for US-101, I-880, SR-152, I-80, and I-580 would be constructed within or adjacent to existing transportation corridors. These improvements would be highly incompatible with existing land use in the US-101 and I-880 corridors, which are immediately adjacent to many residential neighborhoods and commercial businesses.

The airport improvement options at SJC would occur mostly on existing transportation, industrial, and commercial properties. However, the potential construction of runways on the eastern side

of the facility would be highly incompatible with nearby existing residential neighborhoods and Santa Clara University to the west.

The Modal Alternative highway improvement options would be highly incompatible with local and regional plans that have policies favoring increased transportation alternatives and reduced dependency on the automobile. For example, the highway improvement options would support a long-term dispersed pattern of development in the Bay Area to Merced region, which would be inconsistent with local and regional land use planning objectives that promote transit-oriented development around transit nodes as the key to more orderly and sustainable growth. However, the proposed aviation improvements at OAK and SJC would both be compatible with regional RTPs and local general plans addressing airport expansion.

HST Alternative: The Hayward/Niles/Mulford UPRR option would require additional rail track through the Don Edwards San Francisco Bay National Wildlife Refuge, and the northern tunnel and tunnel under park options would require the construction of a new transportation corridor from an eastern terminus north of Merced to the intersection with the Caltrain/UPRR corridor. All three options would potentially be highly incompatible with existing land use because these new corridors would primarily pass through agricultural land and parkland, although the extensive tunnels proposed with these options would avoid most potential parkland impacts. The minimize tunnel option would also require the construction of a new transportation corridor north of Merced, which would be incompatible with existing land use because it would cross at grade through a portion of Henry W. Coe State Park. The Gilroy bypass alignment option (Morgan Hill/Caltrain/Pacheco Pass alignment) would require the construction of a new transportation corridor from its eastern terminus north of Merced to the intersection with the Caltrain/UPRR corridor just north of Gilroy. The new section between the proposed Los Banos Station and the Caltrain/UPRR corridor would have low to moderate compatibility with existing land uses as it passes at grade through agricultural lands, including the Pacheco Creek Valley and Santa Clara Valley. The Gilroy alignment option (Caltrain/Gilroy/Pacheco Pass alignment) would have similar impact levels to agricultural land. Most proposed station sites would be consistent with existing land uses. However, the proposed Gilroy Station site would be potentially incompatible with existing adjacent low-density residential uses and historic structures. Its location, however, would be consistent with policies and actions stated in the Gilroy general plan (City of Gilroy 2002) that place a high priority on strengthening and restoring the downtown area, including the development of an active multi-modal transit center. All of the proposed station sites for the HST Alternative in this region are consistent overall with local and regional plans emphasizing the development of intercity rail service, transportation alternatives, and transit-oriented development. No potentially high impacts are identified in this region.

Communities and Neighborhoods

Modal Alternative: The Modal Alternative highway improvement options would be constructed within or adjacent to existing transportation corridors and are not anticipated to create new physical barriers that would divide neighborhoods or communities.

High-Speed Train Alternative: In locations where the HST Alternative would create a new transportation corridor (such as between San Jose and Merced), the alignment would primarily pass through agricultural or open space lands and would not result in community cohesion impacts in neighborhoods. In the San Francisco to San Jose segment, the corridor would be primarily within an existing active commuter and freight corridor and therefore would not constitute any new physical barriers that would divide neighborhoods or communities. Also, proposed grade separations would not create new barriers. In the San Jose to Oakland segment, the alignment options would be constructed in a tunnel, on an aerial structure, or within an existing rail right-of-way and would not create community cohesion impacts.

Property

Modal Alternative: The highest potential for property impacts due to Modal Alternative highway improvements would occur primarily in urbanized and built-up areas, such as US-101 between San Francisco and San Jose, I-80 between Oakland and Solano County, and most of I-880. Other areas of potential high impacts include the western portion of I-580, and I-80 in the Dixon area. In these locations, the existing facility is built out to the edge of the right-of-way; expansion of these facilities would require additional right-of-way and would have a greater potential for impacting the adjacent dense development.

The lowest potential for property impacts would occur in areas where the densities of development are lower, such as I-580 west of I-5, SR-152, and US-101 south of the San Jose area. Overall, about 140 mi (225 km) of highway alignment improvements (40% of total highway length in the region) would potentially result in high property impacts, and 54 mi (87 km) of alignment (15% of total Modal Alternative highway alignment in the region) would potentially result in medium impacts. About 158 ac (64 ha) around OAK and SJC would potentially result in high property impacts, and 533 ac (216 ha) would potentially result in medium property impacts (see Figure 3.7-5).

High-Speed Train Alternative: The proposed San Jose to Merced alignment options would require new right-of-way. However, since these alignments would traverse areas with agricultural or open space land uses, they would be expected to result in a low potential for property impacts on homes or buildings. Areas of potentially higher property impacts would be expected in built-up locations where the alignments would be located adjacent to the existing transportation corridor or in a new corridor. This would occur in San Francisco south of the proposed 4th and King Station on the Caltrain alignment, and north of the proposed San Jose Station on the I-880 alignment. Between 3 mi (5 km) and 11 mi (18 km) of rail alignment and station locations in the Bay Area to Merced region (between 1% and 5% of total alignment) would potentially result in high property impacts, and between 4 mi (5km) and 9 mi (14 km) of alignment and station locations (between 2% and 5% of total alignment) would potentially result in medium land use impacts (see Figure 3.7-6). Overall, there would be a low potential for property impacts in this region because the rail improvements would be mostly contained within existing right-of-way or in new corridors that are in tunnels or traverse open space.

Environmental Justice

Modal Alternative: Substantial percentages of minority populations are located in the study area for the highway improvement options included in the Modal Alternative (with the exception of the I-580 corridor, which has 40%). For example, the US-101 corridor study area has 68% minority population, I-880 68%, SR-152 60%, and I-80 65%. The OAK and SJC airport study areas both have minority populations of 54% in their study areas.

However, the potential for disproportionate impacts would be expected to be low because most of the highway expansion would occur in the existing right-of-way and would incorporate mitigation to reduce potentially significant adverse effects.

High-Speed Train Alternative: The HST Alternative study area in this region includes a variety of neighborhoods and a diverse multiethnic population. The study areas for all of the proposed HST alignment options have substantial percentages of minority populations. For example, the San Francisco to San Jose study area has a minority population of 52%, Oakland to San Jose 71%, and San Jose to Merced 64%. Significant minority populations were also identified in the vicinity of eight proposed station locations (Los Banos, Gilroy, Santa Clara, Union City, Auto Mall Parkway, Coliseum BART, 12th Street/City Center, and West Oakland). With the exception of the San Jose to Merced alignment, the alignment options would be along existing transportation corridors, and would not be expected to result in disproportionate impacts. Because San Jose to

Figure 3.7-5
Potential Property Impacts Bay Area to Merced
Modal Alternative

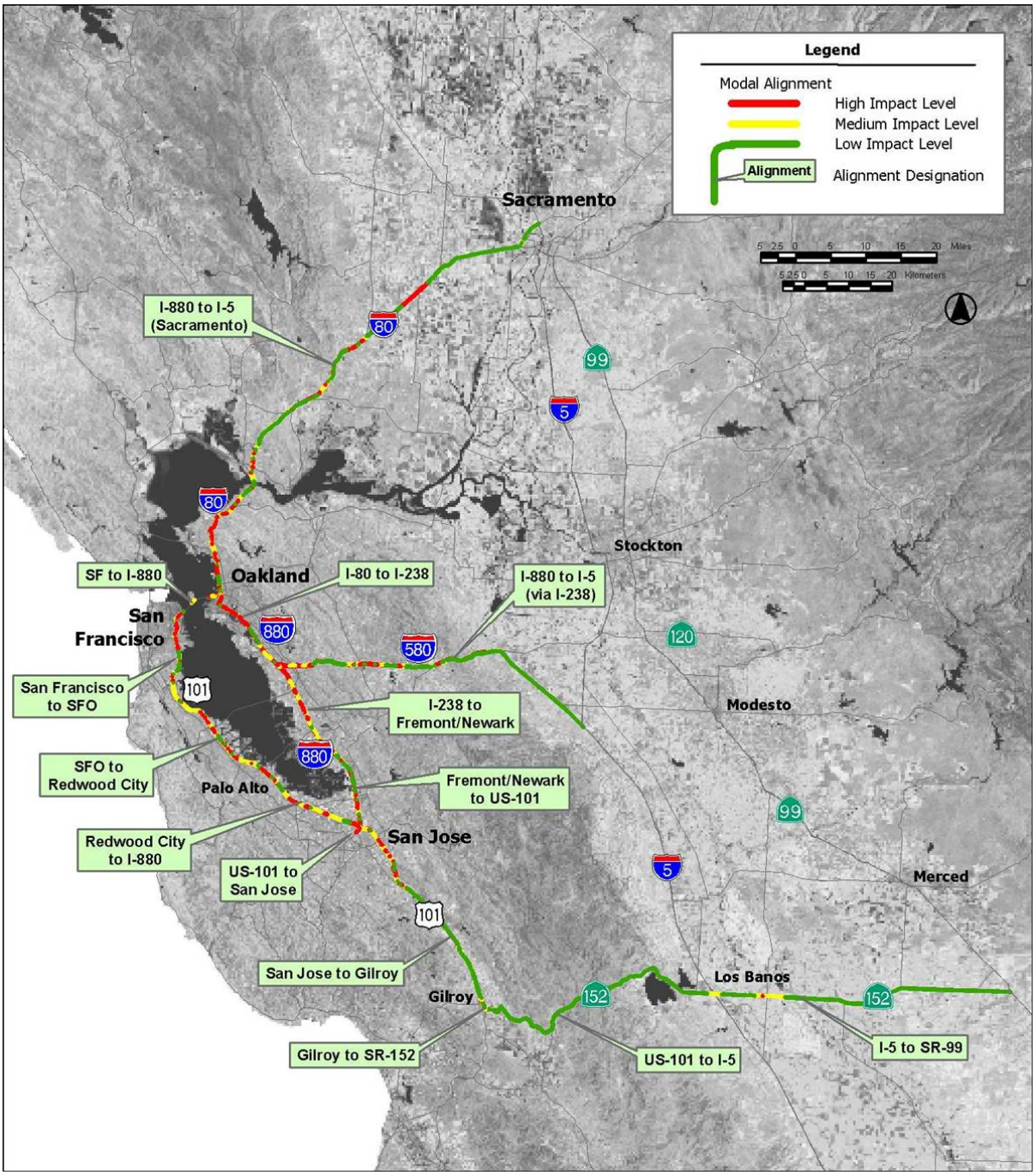
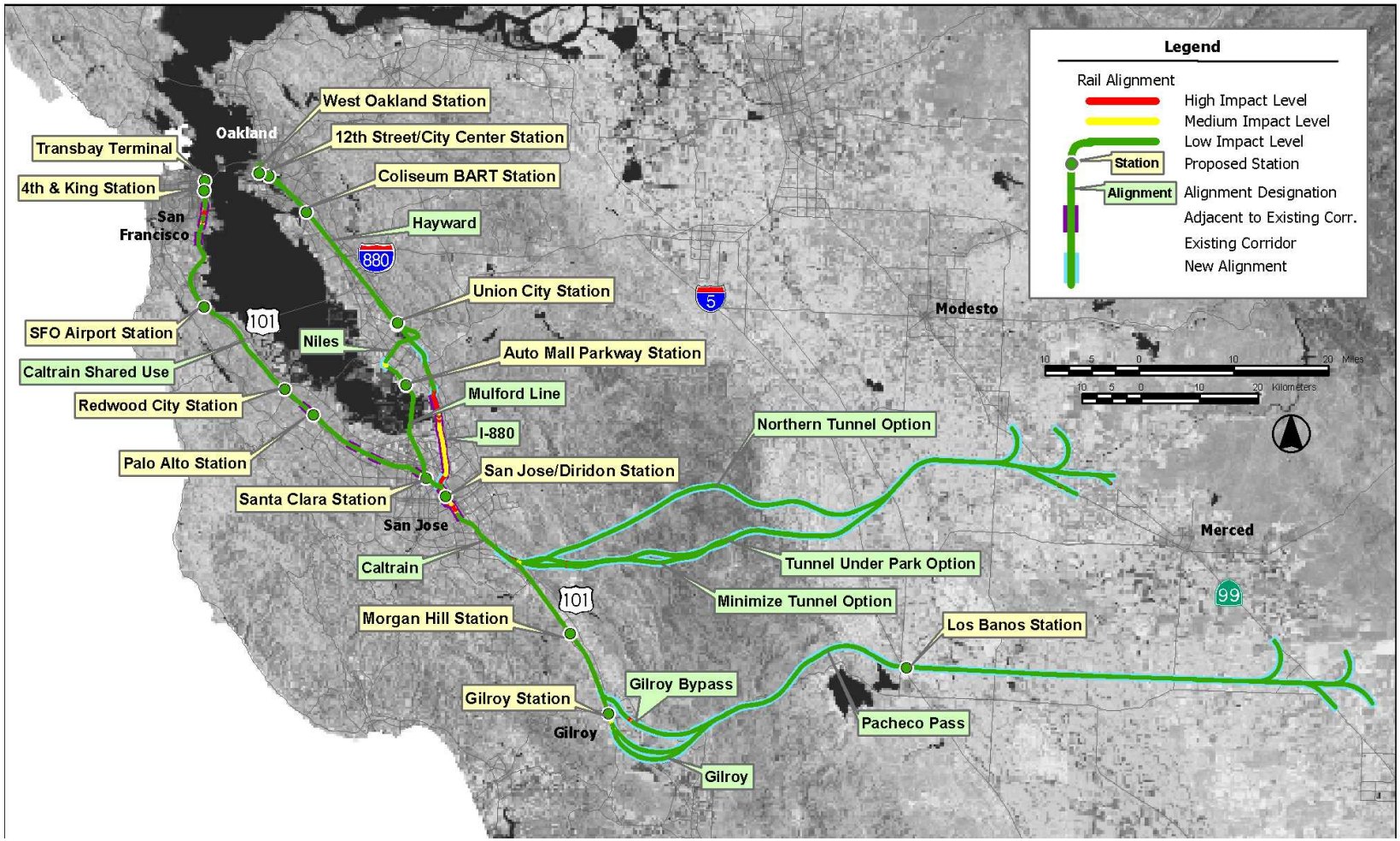


Figure 3.7-6
Potential Property Impacts Bay Area to Merced
HST Alternative



Merced would be a new alignment, there would be a somewhat higher potential for impacts, but impacts would be reduced through the inclusion of feasible mitigation measures.

High-Speed Train Alignment Options Comparison

The Merced to San Jose HST alignment options would be the least compatible with existing land use because these options would require the construction of a new transportation corridor from the eastern terminus near Merced to the intersection with the Caltrain/UPRR rail corridor. Land use compatibility ratings along these segments of the alignment options would range from low to medium. The minimize tunnel option in the Diablo Range direct alignment options would be the least compatible because it would cross at grade through a portion of the Henry W. Coe State Park. The Caltrain/Gilroy/Pacheco Pass alignment option would be the most compatible because it would extend further south to connect with the UPRR alignment and continue to a station at Gilroy. The Hayward/I-880 option would have a higher potential to impact residential property than the Mulford Line option. However, the Mulford Line option would impact the Don Edwards San Francisco Bay National Wildlife Refuge.

B. SACRAMENTO TO BAKERSFIELD

Land Use Compatibility

Modal Alternative: The Modal Alternative would include a wide range of highway improvements throughout the Sacramento to Bakersfield region, and expansions at the Sacramento and Fresno airports. The included changes to the transportation facilities would primarily occur at grade and involve widening of the major intercity travel routes, including changes on I-5, SR-99, SR-152, SR-33, I-80, and I-580 in this region. Because existing land use is predominantly agricultural and the improvements would involve widening of the existing right-of-way, the proposed highway and airport improvements would be potentially incompatible with surrounding land uses. About 44% of the land in the study area in this region is devoted to cropland and orchards, and more than half of the area along the roadways is designated for croplands and pasture. Residential land use comprises about 7%. About 9% of the land is designated for residential use, and a similar amount of commercial/services and industrial uses (about 7%) is proposed along the roadways.

Improvements that would involve widening of existing corridors would be potentially incompatible with future plans due to agricultural designation. The proposed widening of SR-99 would be potentially inconsistent with general plan policies that designate more than a third of land in this corridor for residential development. Similarly, more than half of the land along the I-5 corridor is designated for agricultural and natural open space uses, which would be considered incompatible with roadway improvements. In some locations that have been designated for predominantly agricultural use, the highway improvements would have a potentially high incompatibility because they would be inconsistent with general plan policies to protect and maintain agricultural production.

Future land use around Sacramento International Airport is projected to be primarily transitional uses (uses other than residential and agricultural); therefore, airport expansion would be largely compatible with future plans.

High-Speed Train Alternative: The potential effects of the proposed HST alignments would be similar to those of the Modal Alternative in that the vast majority of the land uses along the proposed right-of-way are designated agricultural. Most segments in this region would require additional right-of-way for HST, and therefore would not be compatible with existing land use. The proposed Truxton (Union Avenue) Station site was also rated as having a high potential incompatibility with existing land use. The area around the proposed station site currently contains a high percentage of low-density residential development. This station would be located

in the Tulare to Bakersfield segment on the UPRR corridor. The proposed Castle Air Force Base (AFB) station site would also not be compatible with existing agricultural uses. The site is also designated for agricultural use in the City of Merced's general plan (City of Merced 1997). Castle AFB is designated for redevelopment. In the Sacramento to Stockton segment, most of the land adjacent to the eight proposed alignment options has been designated for agricultural use in general plans. Four of these alignments also traverse a high percentage of land designated for residential use and therefore would be considered to have a high potential incompatibility with land use plans. Two of these alignments would use the UPRR corridor; the other options would use the CCT corridor. Both the UPRR and CCT alignments have options to link the Sacramento Downtown Station and the Power Inn Road Station with Stockton. In general, the CCT route tends to traverse slightly more land designated for residential and agricultural use than the UPRR route, which would make the CCT route potentially less compatible with future land uses.

Between Stockton and Modesto, the alignment option that would use the UPRR corridor would pass through an area designated for a large portion of residential use (UPRR alignment to Modesto Downtown Station) and would therefore be incompatible with future land use.

Communities and Neighborhoods

Modal Alternative: For much of the Sacramento to Bakersfield region, the highway component of the Modal Alternative would involve widening I-5 and SR-99 by two lanes. Communities in the urbanized portion of Sacramento could be affected by widening I-5, but for much of its length from Sacramento to Bakersfield, I-5 is bordered by agricultural uses or highway commercial uses set back from the right-of-way. Widening SR-99, if it occurs within the existing right-of-way, would not be expected to result in a detrimental physical division of existing communities, because the existing roadway already creates a physical separation between land uses on either side of the highway. However, there are instances throughout the region where the widening would require additional right-of-way and involve displacement of adjoining land uses. The displacement of these uses could potentially increase physical separation that already exists.

High-Speed Train Alternative: For much of the Sacramento to Bakersfield region, the proposed HST routes follow existing rail lines—UPRR, BNSF, or CCT. In many cases, smaller rural communities developed along the railroad tracks. In larger communities, the rail lines already divide the community. A parallel, at-grade set of tracks for HST would therefore not generally be expected to result in a substantial increase in physical separation which exists between land uses on either side of the tracks.

Property

Modal Alternative: The highest potential for property impacts due to potential highway improvements included in the Modal Alternative would occur in the urbanized areas along I-5 and SR-99 in the vicinity of Sacramento, Stockton, Modesto, Merced, Fresno, and Bakersfield. More specifically, there would potentially be high and medium property impacts on I-5 and SR-99 in the Sacramento area and on I-5 between Sacramento and Stockton. The majority of the high-impact areas include the portion of SR-99 between Sacramento and Merced. Other areas of potentially high property impacts include areas further south on SR-99 from SR-152 to Bakersfield. The area along I-5 between Stockton and SR-99 has the potential to result in medium impacts on property. Overall, approximately 52 mi (84 km) of highway alignment (8% of total Modal Alternative highway alignment in the region) would have a high potential for property impacts, and 92 mi (153 km) of alignment (15% of total Modal Alternative highway alignment in the region) would have a medium potential for property impacts. The lowest potential for property impacts would occur in less-developed and rural areas along I-5 and SR-99 (see Figures 3.7-7 and 3.7-8).

Figure 3.7-7
Potential Property Impacts Sacramento to Bakersfield (North)
Modal Alternative

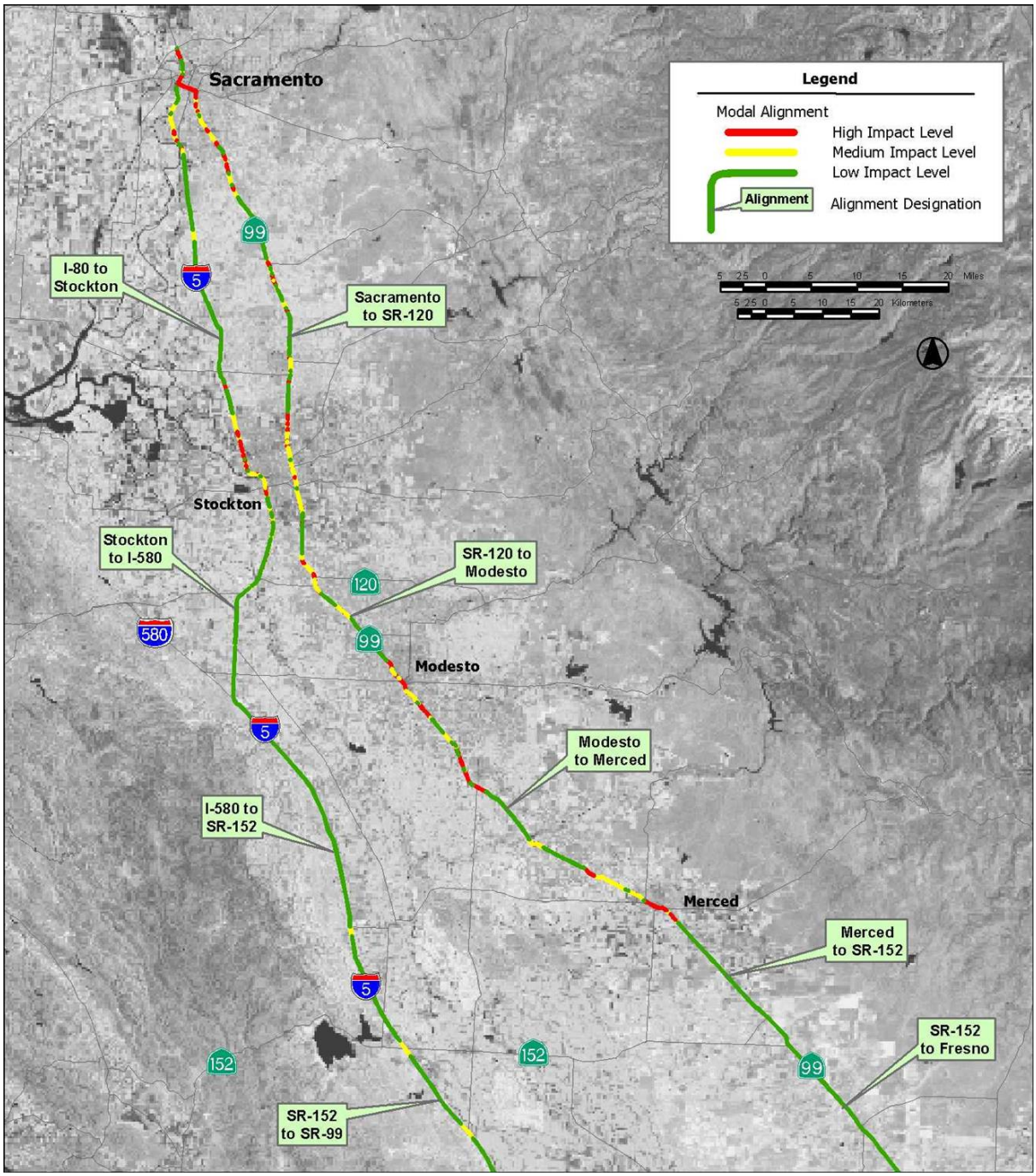
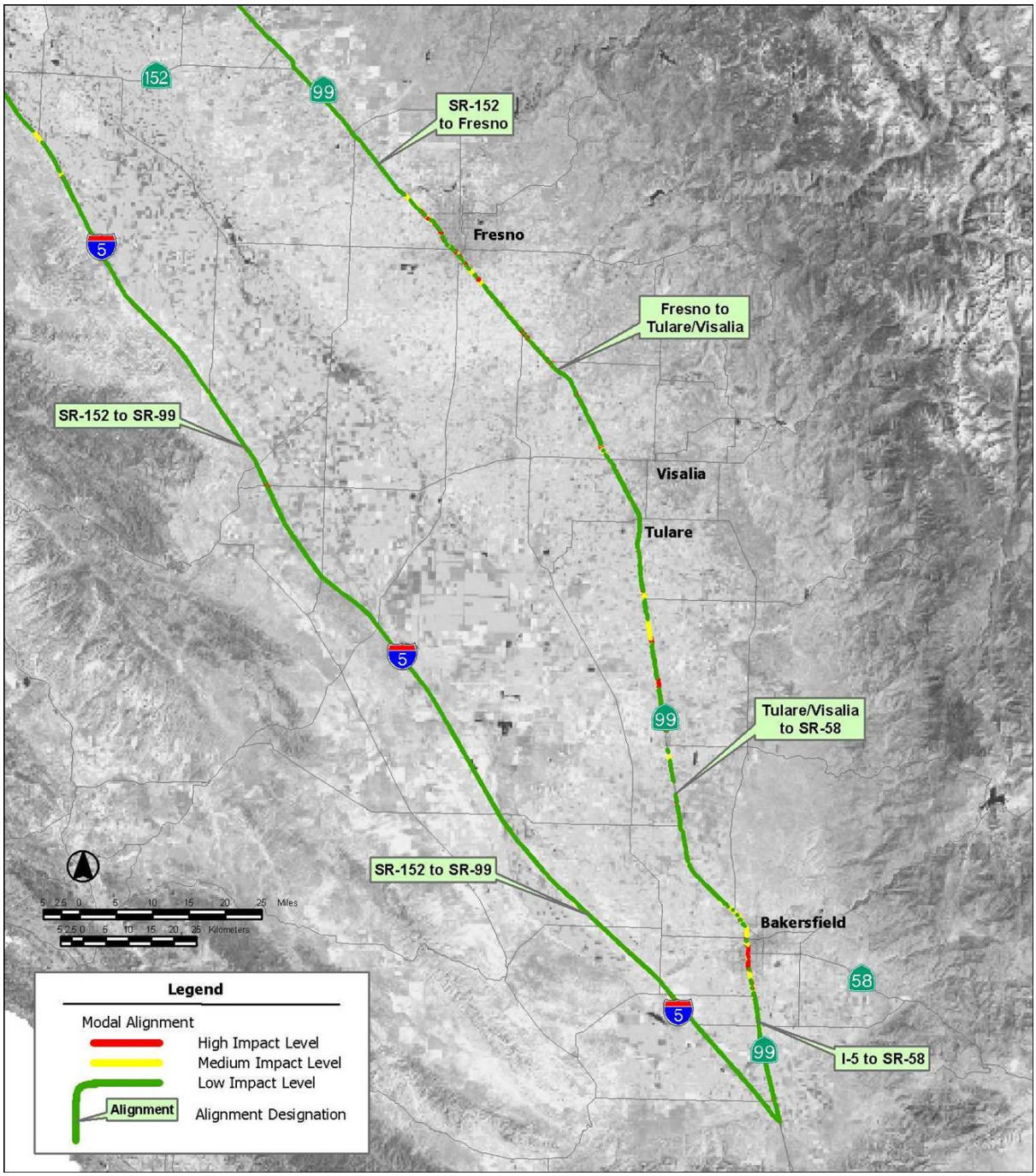


Figure 3.7-8
Potential Property Impacts Sacramento to Bakersfield (South)
Modal Alternative



High-Speed Train Alternative: Under the HST Alternative, areas of potentially high property impacts would occur in the vicinity of urbanized areas where the alignments would be located adjacent to an existing transportation corridor. Between Sacramento and Stockton, the proposed easterly CCT alignment traverses primarily rural lands resulting in a low property impact potential. However, there is a small section of this corridor segment approximately 10 mi (16 km) south of the Power Inn Road Station site that would potentially result in high property impacts. The Power Inn Road Station site is located adjacent to an existing corridor and would result in a medium potential for property impacts. Other areas of potentially high and medium impacts are located between Stockton and Merced along both the UPRR and BNSF alignments. These potential impacts are due to new alignments impacting existing development and alignments located adjacent to existing corridors but outside the existing right-of-way, thereby impacting existing development.

The area from Merced to Fresno is largely agricultural land and therefore the potential to impact property is low. However, potential impacts on property along the UPRR and BNSF alignments directly north of the Fresno Downtown Station and continuing south to Bakersfield would be considered high to medium due to new alignments, and because the property is adjacent to an existing corridor. Between 20 mi (32 km) and 25 mi (40 km) of rail alignment and station locations (between 6% and 8% of total HST alignment in the region) would potentially result in high property impacts, and between 23 mi (37 km) and 67 mi (108 km) of alignment and station locations (between 7% and 20% of total HST alignment in the region) would potentially result in medium property impacts (see Figures 3.7-9 and 3.7-10).

Environmental Justice

Modal Alternative: For the Modal Alternative, minority populations were identified in the Modesto to Merced corridor. Communities in this corridor include Ceres, Keyes, Turlock, Delhi, Livingston, Atwater, and Merced. In this study area for this portion of the SR 99 alignment included in the Modal Alternative, the percentage of minorities is about 46%, compared to 35% in the region as a whole. In other corridors in the Sacramento to Bakersfield region, the percentage of minority populations is lower.

High-Speed Train Alternative: For the HST Alternative, minority populations have been identified near several potential station location options. These include the proposed stations and maintenance facilities locations in the Sacramento area (downtown Sacramento Valley Station, Power Inn Road BNSF and UPRR options, and the Sacramento Maintenance Facility BNSF and UPRR options); Stockton ACE Downtown Station; the Modesto Downtown Station; both Merced station sites (Merced Downtown Station and Merced Municipal Airport Station); Fresno Downtown Station; Hanford Station; and Truxton stations (Union Avenue and Amtrak) in Bakersfield.

In addition, the alignment options between Merced and Fresno and from Tulare to Bakersfield would be expected to pass through areas with predominantly minority populations. The potential impacts, if any, for these communities would depend in part on the extent of new right-of-way that would be required for the HST Alternative. Where bypass options would be considered in addition to a mainline option, there would be greater potential for impacts.

High-Speed Train Alignment Options Comparison

The proposed Truxton (Union Avenue) Station site, which would be located in the Tulare to Bakersfield segment along the UPRR, is adjacent to a relatively high percentage of residential development, and the HST Alternative would be potentially incompatible with existing land uses. The Sacramento to Stockton corridor on the UPRR alignment is designated as predominantly agricultural and residential land uses, which would be potentially incompatible with the HST Alternative. The proposed UPRR alignment in the Stockton to Modesto corridor would also be incompatible with existing land uses due to proposed residential uses. In the Fresno to Tulare

Figure 3.7-9
Potential Property Impacts Sacramento to Bakersfield (North)
HST Alternative

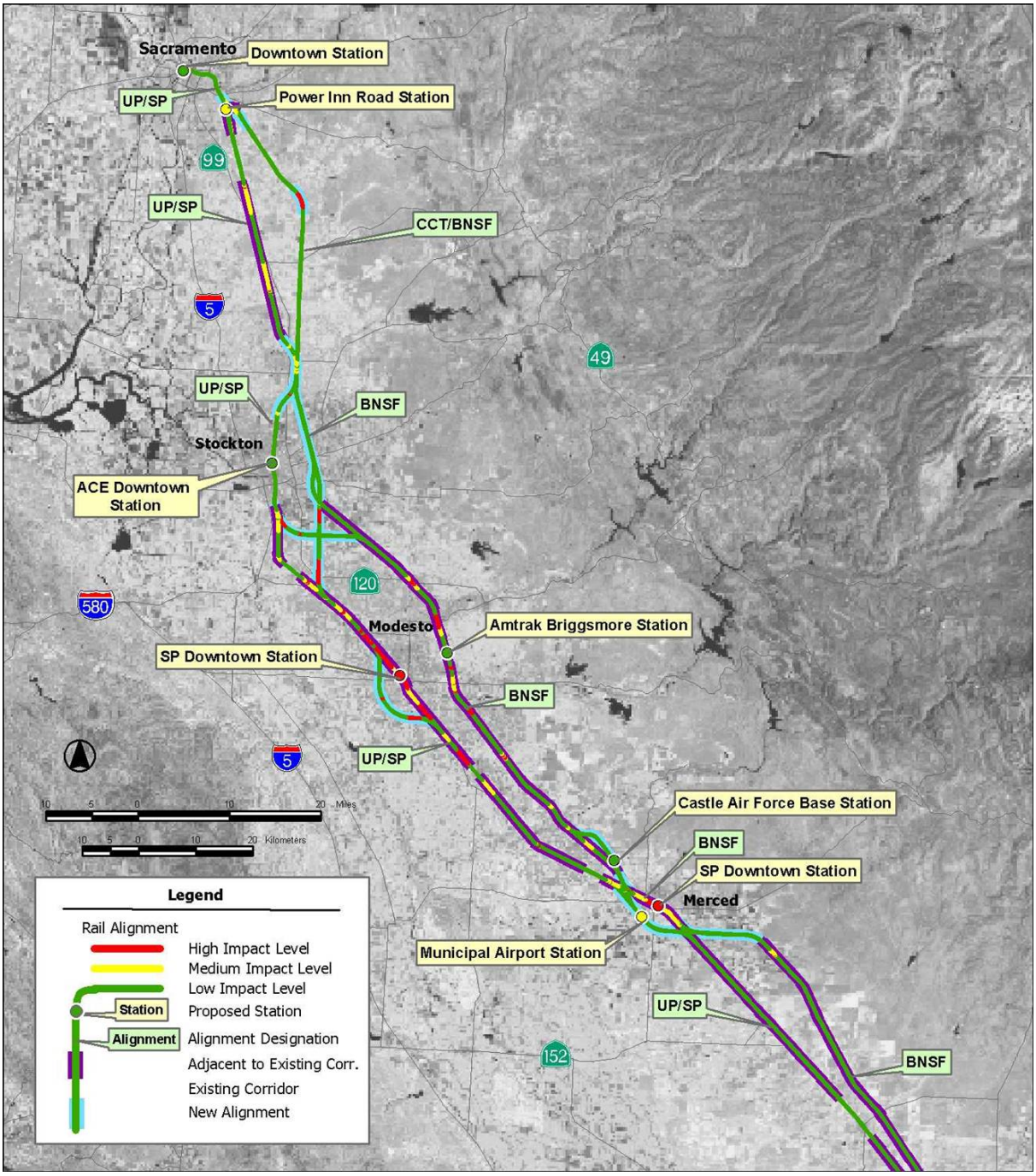
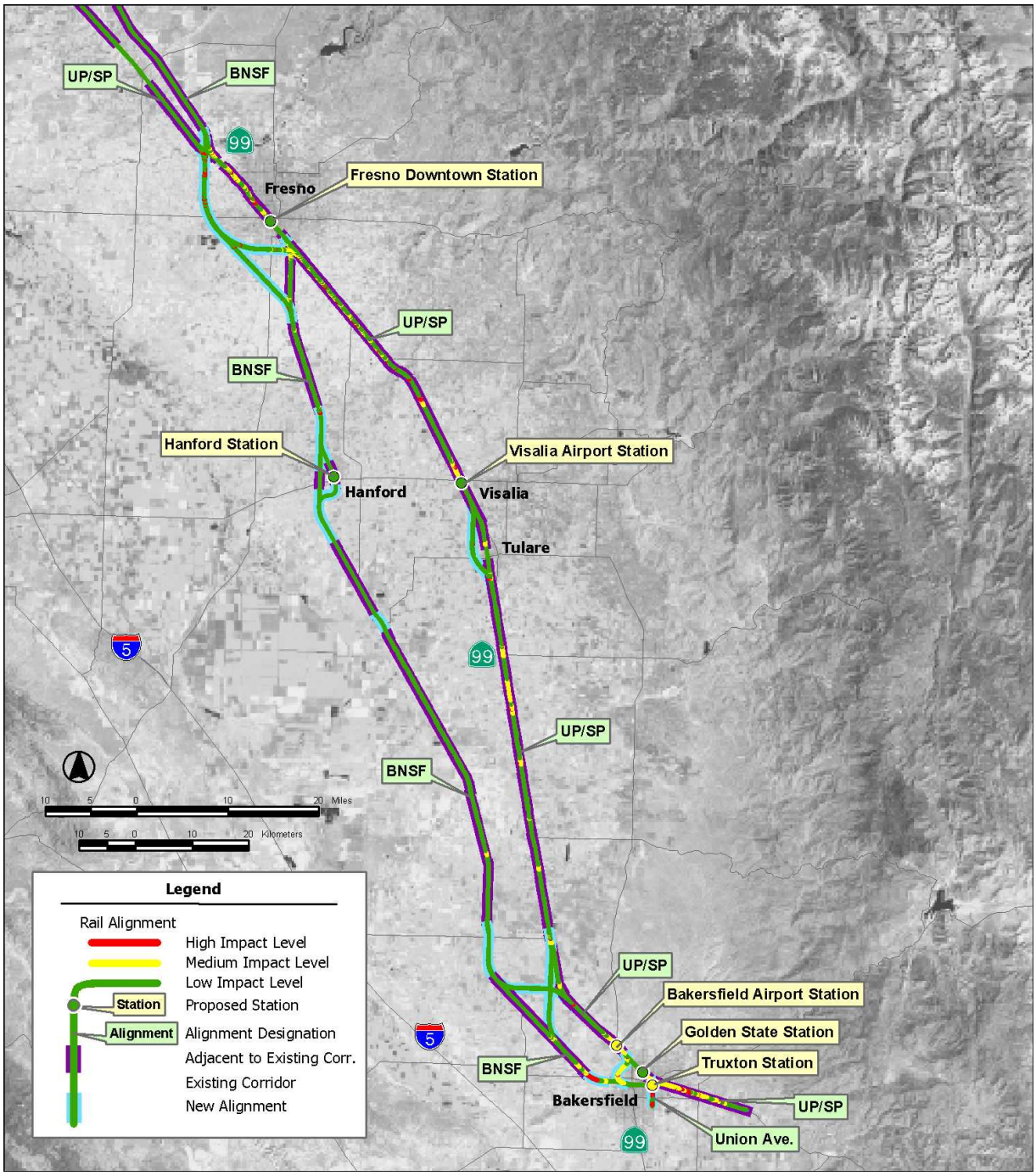


Figure 3.7-10
Potential Property Impacts Sacramento to Bakersfield (South)
HST Alternative



corridor, the proposed alignment along the BNSF route to Hanford Station would be potentially incompatible with existing land uses. In the Truxton to Bakersfield corridor, the proposed Truxton UPRR Station option and the main maintenance facility BNSF option would be potentially incompatible with the high percentage of land designated for future residential uses.

Minority or low-income populations exceeding 50% of the population as a whole, or 10% greater than the minority population in the community as a whole, were identified in the following alignment options and station study areas: all of the proposed sites for stations and maintenance facilities in the Sacramento to Stockton corridor, Modesto Downtown Station (Stockton to Modesto corridor on the UPRR alignment), all station areas in the Modesto to Merced corridor, Fresno Downtown Station area and all alignments in the Merced to Fresno corridor, Hanford Station area (Fresno to Tulare corridor on the BNSF corridor), Truxton (Union Station) and Truxton (Amtrak) Station areas, and most alignments in the Tulare to Bakersfield corridor.

In the Tulare to Bakersfield corridor, the proposed Truxton (Union Avenue) Station site would result in high land use incompatibility impacts. The Tulare express loop would somewhat reduce displacement impacts, but it would divide an established community.

C. BAKERSFIELD TO LOS ANGELES

Land Use Compatibility

Modal Alternative: The Modal Alternative includes potential highway improvements to I-5, SR-58, and SR-14. Widening that would require right-of-way outside of the existing corridor would be needed on most of the segments of I-5, as well as the segment of SR-14 between Palmdale and I-5. The widening of I-5 would be incompatible with the designated significant ecological areas (described in Section 3.15, *Biological Resources and Wetlands)* between SR-99 and SR-14 and other adjacent land uses. Similarly, the widening of SR-14 would be incompatible with existing agricultural and residential land uses.

The Modal Alternative would also include the expansion of the Burbank-Glendale-Pasadena Airport. Expansion of this airport would be incompatible with nearby residential neighborhoods as well as the local airport authority's plan to discontinue airport expansion.

High-Speed Train Alternative: Most of the proposed alignment options in this region would be constructed outside of existing transportation right-of-way, either highway or rail, and would require new right-of-way. The new right-of-way would generally follow the existing transportation corridor. In these locations, the alignments would be potentially incompatible with existing land uses. These locations include the I-5/Wheeler Ridge alignment option because it would not stay consistently within the SR-184 corridor and would traverse single-family residential neighborhoods and agricultural lands. A similar situation would occur with the SR-58/Soledad Canyon corridor alignment. Other alignment options that would require new right-of-way include the Palmdale Station siding (a length of track for passing trains at the Palmdale Station) and the MTA/Metrolink and combined I-5/Metrolink options, including the I-5 Burbank downtown siding, I-5 downtown Burbank to LAUS (cut and cover at Silver Lake), I-5 downtown Burbank to LAUS (aerial at Silver Lake), LAUS existing siding, LAUS existing south, LAUS south siding, LAUS existing east, and east connection.

The proposed I-5 Tehachapi Mountain crossing would also be constructed outside of an existing rail transportation right-of-way. However, the alignment would follow the existing road transportation corridor, and it would be constructed mostly within tunnels. Therefore, it would be compatible with existing uses. The section along cut and fill near Tejon Lake in Castaic Valley may be inconsistent with potential Tejon Ranch plans to build low-density residential units on

lands adjacent to Tejon Lake. Two proposed HST station sites, at Sylmar and Burbank, were considered incompatible with existing land uses because they would be located in neighborhoods with a high proportion of low-density residential uses. However, these stations would be consistent with local plans to encourage mixed-use development and focus development near transit stations.

Communities and Neighborhoods

For the Modal Alternative, the included highway improvements would occur in existing transportation corridors and therefore would not create new divisions or barriers in existing neighborhoods.

For the HST Alternative, the alignment options were anticipated to have an adverse impact on community cohesion if they would divide an existing neighborhood, resulting in decreased access within the community. The new Union Avenue corridor would pass through and divide an established residential area in southern Bakersfield.

Property

Modal Alternative: The highest potential for property impacts due to Modal Alternative highway improvements would occur primarily in urbanized areas. The northern portion of this region is largely agricultural, and the potential for property impacts would be low. The central portion of this region traverses the mountains and is largely rugged and undeveloped land. This portion also crosses the high desert, including the communities of Palmdale and Lancaster. Although this segment crosses these communities, land uses remain mostly rural. The potential for property impacts in this area would also be low. Portions of the Modal Alternative along I-5 that would traverse urban development would potentially result in medium to high impacts.

Upon entering the southern portion of this region (Sylmar to Los Angeles), the land uses become a mix of suburban uses. This portion of the region contains greater potential for medium to high property impacts. Overall, 13 mi (21 km) of highway alignment (6% of total Modal Alternative highway alignment in the region) would potentially result in high property impacts, and 24 mi (39 km) of alignment (11% of total Modal Alternative highway alignment in the region) would potentially result in medium property impacts. Approximately 107 ac (43 ha) of land around the Burbank-Glendale-Pasadena Airport expansion would have a high potential for property impacts, and 350 ac (142 ha) of land around the airport would have a medium potential for property impacts (see Figure 3.7-11).

High-Speed Train Alternative: Much of the proposed I-5 and SR-58/Soledad Canyon alignments would require new right-of-way. A large majority of these alignments traverse areas with open space or agricultural land uses and would be expected to have a low potential for property impacts. However, portions of these alignments would pass through urbanized areas and would therefore have a medium to high potential for property impacts, e.g., the Sylmar to Los Angeles segment, including the alignment along I-5 between Burbank Metrolink/Media City Station and the existing LAUS. Overall, between 4 mi (6 km) and 15 mi (24 km) of rail alignment and station options (between 3% and 11% of total HST alignment in the region) would potentially result in high property impacts, and between 4 mi (6 km) and 15 mi (24 km) of alignment and station locations (between 4% and 11% of total HST alignment in the region) would potentially result in medium property impacts. The higher numbers generally reflect inclusion of impacts along the Antelope Valley route (see Figure 3.7-12).

Environmental Justice

Modal Alternative: For the Modal Alternative, minority populations exist in the study area for the I-5 corridor from SR-14 to LAUS and along the SR-58/SR-14 corridor (with an average minority

Figure 3.7-11
Potential Property Impacts Bakersfield to Los Angeles
Modal Alternative

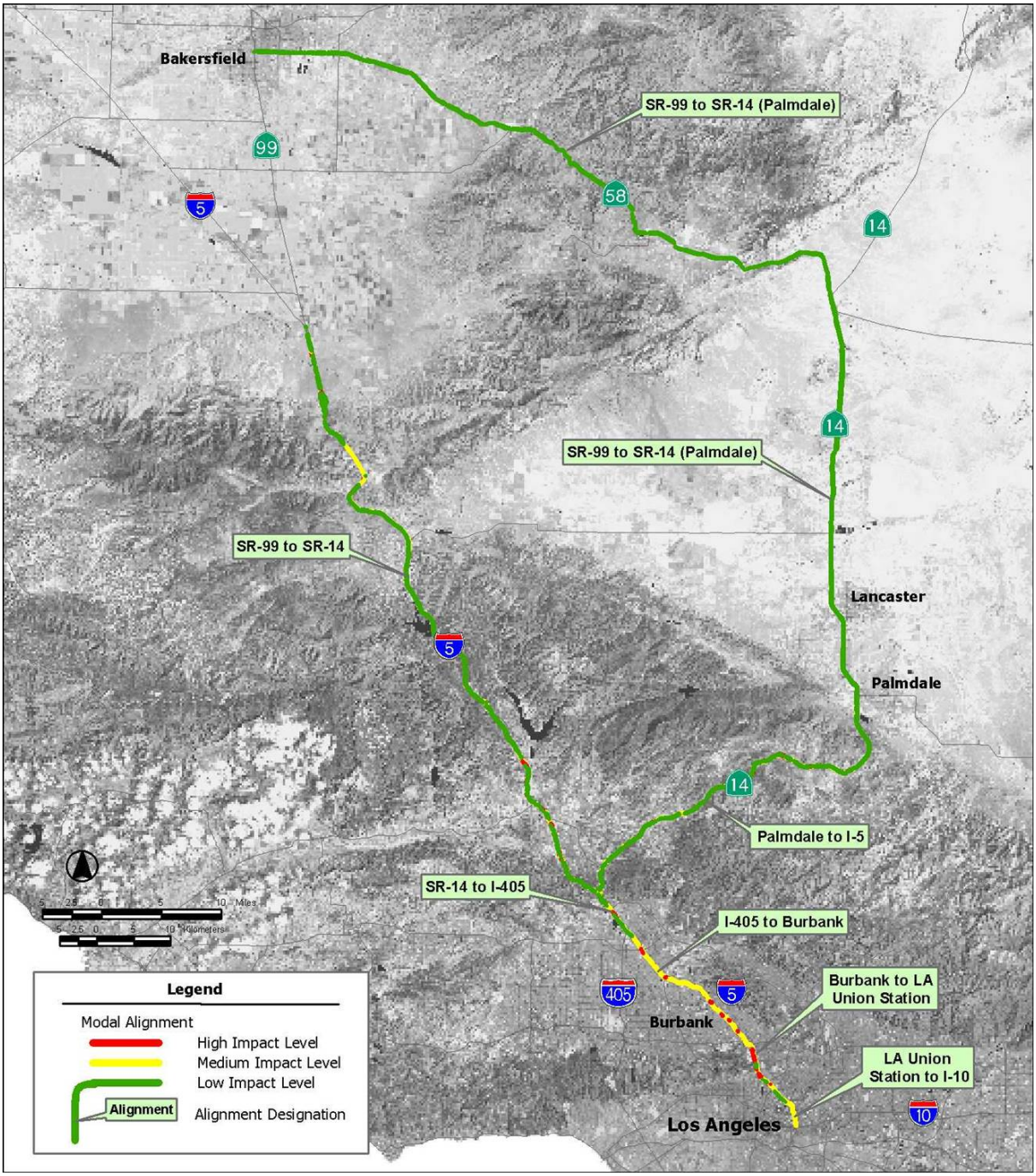
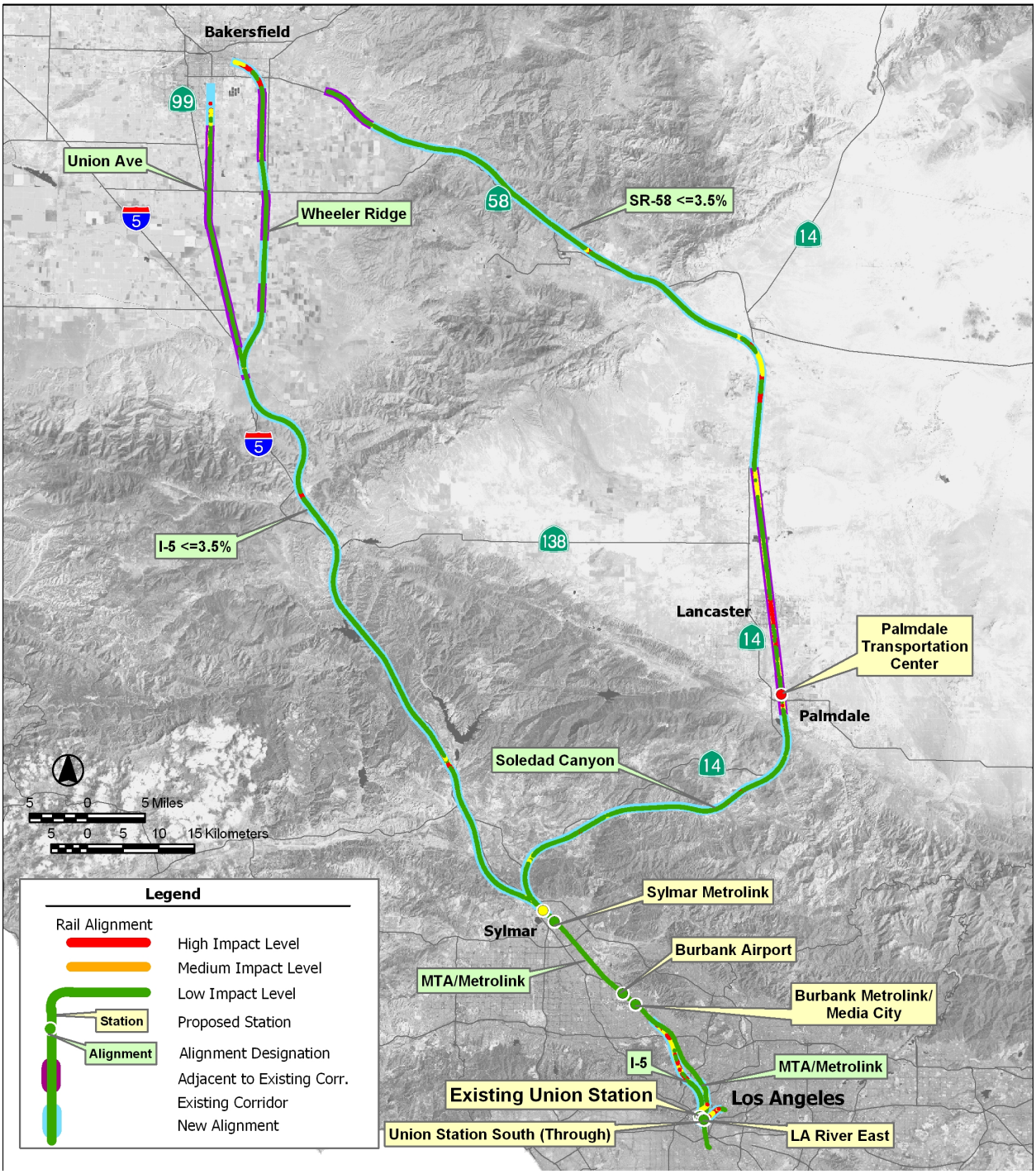


Figure 3.7-12
Potential Property Impacts Bakersfield to Los Angeles
HST Alternative



population percentage of 75%), and at other locations such as the I-5/SR-14 to I-405 and the SR-58/SR-14/SR-99 to Palmdale corridors. However, the highway improvements in these locations would be constructed within the existing right-of-way, which would reduce potential for adverse impacts. Potential for impacts would be greater where new right-of-way would be needed. The population of the study area around the Burbank-Glendale-Pasadena Airport comprises about 80% minorities. The need for additional right-of-way to expand the airport could result in potential impacts.

High-Speed Train Alternative: Minority populations are located in the study area at points along all of the alignment options. For example, the average percentage of minority population for the I-5 Tehachapi Mountain crossing (Wheeler Ridge and Union Ave), Palmdale Station location, and Soledad Canyon alignment is 73%. The potential for impacts would be greater for alignments that would be new transportation corridors. These segments include Wheeler Ridge corridor, SR-58 corridor, Palmdale Station, I-5 Burbank downtown station; I-5 Glendale, I-5 downtown Burbank to LAUS (aerial at Silver Lake), LAUS existing site, LAUS existing south, LAUS south, LAUS existing east, and the east connection.

Minority populations are present in the study areas for the proposed HST stations and the proposed Los Angeles maintenance yard site.

High-Speed Train Alignment Options Comparison

In the Bakersfield to Sylmar segment of the region, the proposed I-5 (Union Avenue and Wheeler Ridge) options would be potentially more compatible with existing land use than the SR-58 option because they would be either within tunnels or would not pass close to low-density residential uses or other sensitive uses, and they do not include proposed stations.

The Sylmar to Los Angeles segment includes two proposed alignment options: MTA/Metrolink or combined I-5/Metrolink. Most of the MTA/Metrolink option would be within an existing rail transportation corridor. Of the three stations proposed for this option, only Burbank Downtown Station would be located in an area with a low percentage of residential uses. Therefore, this alignment option would be moderately incompatible with existing land uses.

There are three proposed alignment options in the downtown Burbank to Los Angeles segment of the region. The I-5 Burbank downtown station option would have potentially high incompatibility because most of this option would not be within an existing transportation corridor and would be above ground as it cuts through low-density residential neighborhoods. However, the proposed I-5 downtown Burbank to LAUS (cut and cover at Silverlake) alignment would be potentially compatible because it would be constructed in tunnel. The proposed Metrolink/UPRR option would also have low incompatibility with existing land uses.

D. LOS ANGELES TO SAN DIEGO VIA INLAND EMPIRE

Land Use Compatibility

Modal Alternative: The Modal Alternative would include highway-widening improvements to I-10, I-15, I-215, I-15, and SR-163. Highway improvements in the LAUS to March ARB segment of the region would not be compatible with existing land use, which includes a high percentage of low-density residential development. Also, large portions of this segment are currently vacant and undeveloped. Expansion of the highway system would be expected to promote sprawl and low-density development and would not be compatible with local plans supporting high-density and transit-oriented development. Similarly, the segment between March ARB and Mira Mesa would also be incompatible with existing land use and future local plans. More than half of the study area in the Mira Mesa to San Diego segment consists of parklands or undeveloped land.

Therefore, the highway improvements in this segment would be incompatible with existing land use and future land use plans.

The Ontario International Airport is located in the LAUS to March ARB segment. Expansion of this airport would be incompatible with existing nearby residential neighborhoods.

High-Speed Train Alternative: Most of the proposed alignment options would be located within or adjacent to existing or planned highway or rail corridors. Two of the three proposed alignment options (UPRR Colton Line and UPRR Riverside/UPRR Colton) from Los Angeles would be located adjacent to the UPRR corridor in urbanized areas, which would be compatible with existing land use. The third option (the loop through San Bernardino) would traverse low-density residential neighborhoods and would be potentially incompatible with existing land uses. However, the San Bernardino Station would be located in a redevelopment area, and the HST Alternative would be compatible with future planned uses at this location.

This region includes one proposed alignment option to connect March ARB with Mira Mesa, and two proposed options for passing through the City of Escondido. The Escondido at SR-78/I-15 Station option would traverse mainly vacant and agricultural lands. This alignment would be located in the existing I-15 corridor and would be moderately compatible with existing land use. For the second option (Escondido Transit Center Station), the largest single land use in the corridor is single-family residential, followed by multifamily and commercial and office space. Although the large presence of residential uses is less compatible with HST, the potential for intra-city connectivity at the existing Escondido Transit Center makes this alignment moderately compatible.

For the third segment connecting Mira Mesa with San Diego, there are three proposed alignment options. The variety of land use along the options via Carroll Canyon and to Qualcomm Stadium via the I-15 corridor reflects the suburban nature of northern San Diego. Undeveloped land and parkland comprise a significant share of the land use along the alignments. All three options would follow existing transportation corridors and therefore would be moderately compatible with existing land use. The alignment option via Miramar Road would not include any stations. The majority of surrounding land use is institutional. Secondary uses are light industrial and undeveloped land. Although the alignment would also traverse the Miramar Memorial Golf Course, it would be located within an existing transportation corridor; therefore, the alignment would be moderately compatible with existing land use.

The two proposed station sites that would be potentially incompatible with surrounding land uses are South El Monte Station and City of Industry Station. This potential incompatibility is due to the more agricultural and residential nature of the areas surrounding the station locations. The proposed Escondido Transit Center Station site would be potentially incompatible with its location in an area of existing residential uses; however, the site would be compatible with local land use plans that support transit development in this area.

Communities and Neighborhoods

Modal Alternative: The Modal Alternative is not anticipated to result in any community cohesion impacts because all of the improvements would occur in existing transportation corridors.

High-Speed Train Alternative: The HST Alternative is not expected to result in any community cohesion impacts because the proposed alignments under consideration would be located in existing transportation corridors and in tunnels.

Property

Modal Alternative: The highest potential for medium to high property impacts would occur in the developed Los Angeles area from Los Angeles to San Bernardino (along I-10). The edge of this right-of-way is densely developed with commercial and residential uses. High to medium property impacts would also potentially occur along I-10, I-15, and I-215 alignments due to residential development. Much of the area in the southern section of this region is occupied by undeveloped and agricultural land. Potential property impacts on those land uses would be low. Overall, 44 mi (71 km) of highway alignment (37% of total Modal Alternative highway alignment in the region) would potentially result in high property impacts, and 44 mi (71 km) of alignment (37% of total Modal Alternative highway alignment in the region) would potentially result in medium property impacts. The Ontario Airport and Lindberg Field expansions would affect 445 ac (180 ha) of high-impact land uses and 142 ac (57 ha) of medium-impact land uses (see Figure 3.7-13).

The major land uses between LAUS and March ARB Station consist of low-density residential buffered from nearby rail corridors by commercial and industrial uses. Much of the alignment is also assumed to be adjacent to the existing highway corridor in this section and therefore is expected to result in mostly high and some medium property impacts. The area from March ARB Station to Mira Mesa Station primarily consists of open space; therefore, potential property impacts would be low. However, there are several areas located adjacent to existing corridors and new alignments that have a potential for medium to high property impacts. Between Mira Mesa Station, Downtown San Diego Station, and the Qualcomm Stadium Station, urban development increases as the alignments travel south, resulting in the potential for medium to high property impacts. There would be a medium potential for property impacts if the Qualcomm Stadium Station were located on the eastern side near multifamily residences.

Between 28 mi (45 km) and 37 mi (60 km) of rail alignment and station locations (between 19% and 22% of total HST alignment in the region) would result in potentially high property impacts, and between 35 mi (56 km) and 54 mi (87 km) of alignment and station locations (between 23% and 33% of total HST alignment in the region) would potentially result in medium property impacts (see Figure 3.7-14).

Environmental Justice

Modal Alternative: Minorities comprise 58% of the population in the study area from LAUS to March ARB. From March ARB to Mira Mesa, the minority population is 27%, and from Mira Mesa to San Diego it is 37%. Because the widening of highways would occur within the existing right-of-way, the potential for impacts would be low; however, for improvements that would need new alignment or required extensive additional right-of-way, the potential for impacts would be greater.

High-Speed Train Alternative: In this region, the HST Alternative would be located mostly within existing transportation corridors, which would limit potential the impacts on nearby communities, but potential for impacts would be greater where new right-of-way would be needed for an alignment option. Minority populations averaging 54% were identified along all of the proposed alignment options connecting Los Angeles to March ARB, including the Pomona (59%) and San Bernardino Station sites (59%), and the March ARB and Escondido Transit Center Station sites (68%) in the March ARB to Mira Mesa segment.

High-Speed Train Alignment Options Comparison

The UPRR Colton Line alignment option in the Los Angeles to March ARB segment and the I-15 alignment option in the March ARB to Mira Mesa segment would be moderately incompatible with existing land use. The Carroll Canyon alignment option in the Mira Mesa to San Diego segment also would be moderately incompatible with existing land use. However, these alignment options

Figure 3.7-13
Potential Property Impacts Los Angeles to San Diego Via Inland Empire Modal Alternative

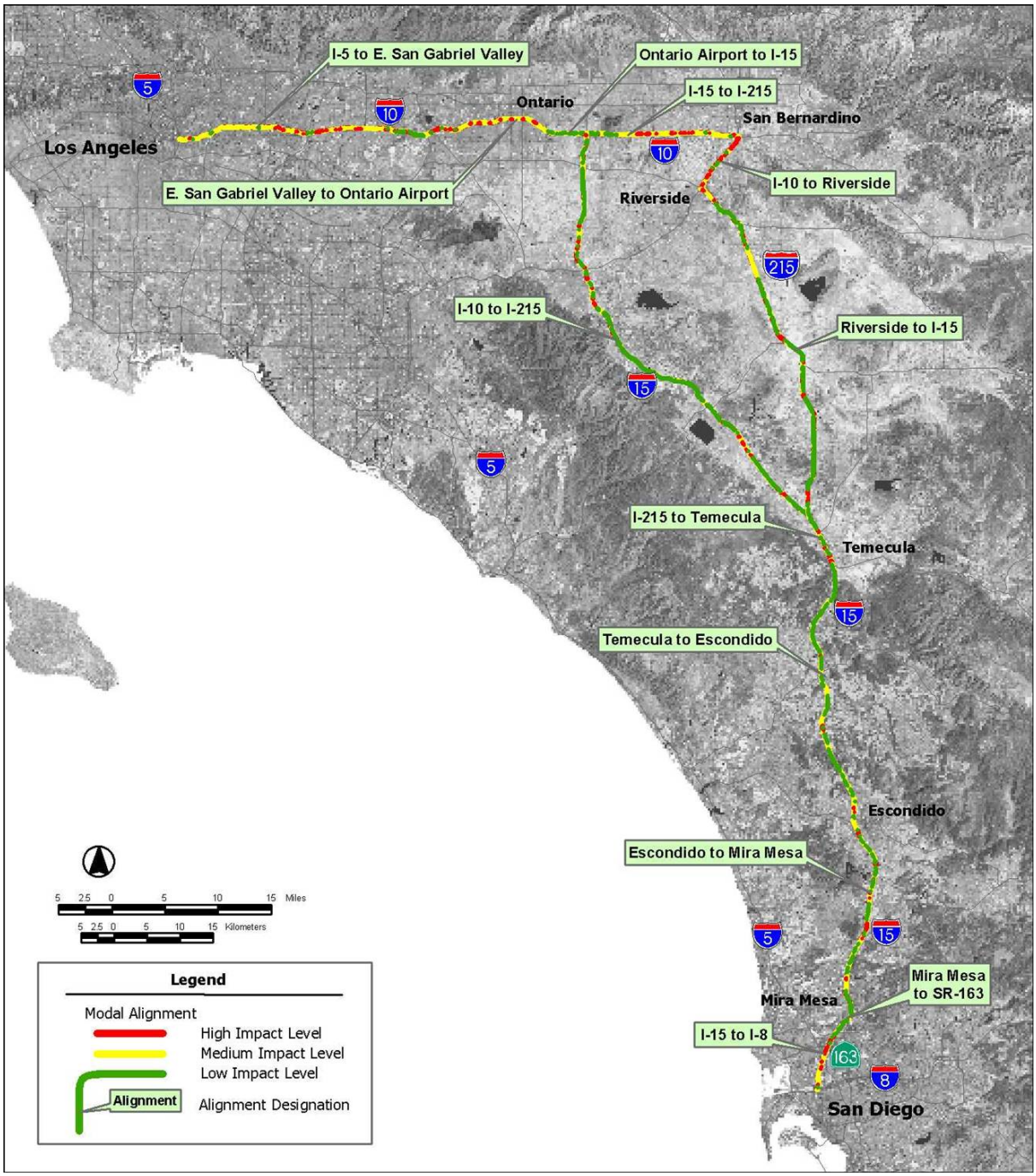
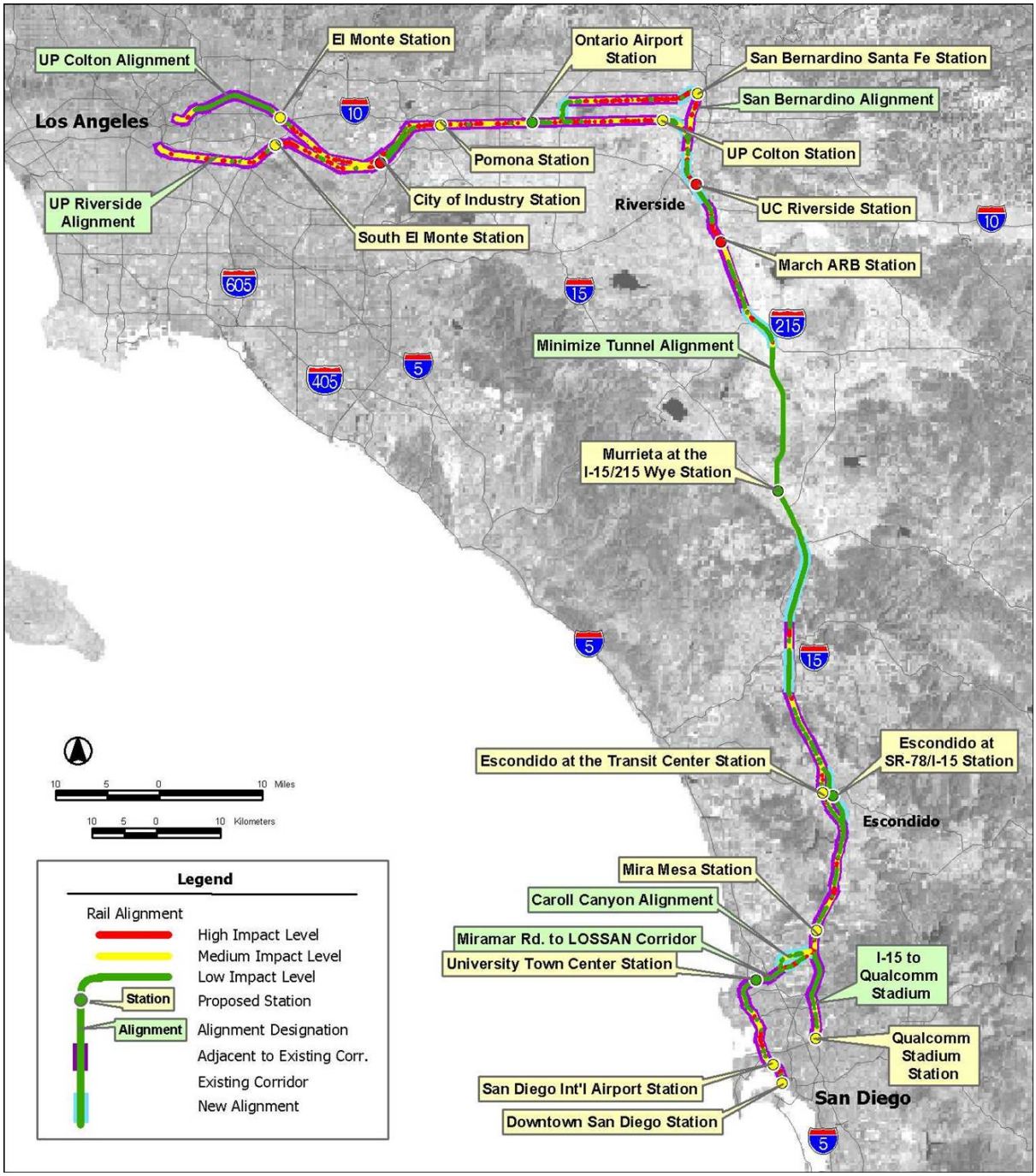


Figure 3.7-14
Potential Property Impacts Los Angeles to San Diego Via Inland Empire
HST Alternative



would be compatible with local plans. These alignments and station locations likely would provide better intercity to intra-city transit connections and would serve larger travel markets. Potential property impacts would be moderate in all of the Los Angeles to March ARB segments. In the Mira Mesa to San Diego corridor, the I-15-to coast via Carroll Canyon segment would have moderate potential property impacts, and the I-15 to coast via Miramar Road segment would have low potential property impacts.

E. LOS ANGELES TO SAN DIEGO VIA ORANGE COUNTY

Land Use Compatibility

Modal Alternative: The Modal Alternative would include the potential addition of nine gates at the Long Beach Airport and the widening of I-5 between Los Angeles and San Diego. The airport expansion would not impact surrounding land uses and would be compatible with existing and planned uses. The established I-5 corridor traverses urban and suburban mixed-use areas and crosses open space and coastal lagoons. The segments of I-5 under residential use are between Encinitas and Solana Beach, Oceanside and Carlsbad, Dana Point and San Clemente, and LAUS and Irvine. Because the highway corridor is established, it is considered compatible with existing land uses and with local plans that continue to recognize I-5 as a major transportation corridor throughout the region, and the improvements, which would be in the corridor, would also be compatible.

High-Speed Train Alternative: Proposed improvements to the LAUS to LAX segment would occur in an existing rail corridor. The existing land uses along this alignment are dominated by industrial and commercial development. Residential land uses in the study area are typically buffered from the rail by non-residential uses. Therefore, the proposed improvements would be compatible with existing and future land uses.

There are two alignment options that would travel south out of LAUS. The first option, connecting LAUS to Anaheim, would use the existing UPRR corridor, and the existing LOSSAN corridor, south of Anaheim to Irvine. Existing land uses along this alignment consist of a mixture of industrial, commercial, and residential. This alignment includes a station option in a commercial area of Norwalk with residential use and a community park located on the opposite side of the rail corridor. With the proximity of the park, the station option would have medium compatibility with land use. However, the alignment and station are generally compatible with existing land use, and they would be compatible with local land use policies to promote the enhancement of transit services and reduction of dependency on automobile use for visitors and residents.

The second alignment option traveling south out of LAUS would connect LAUS to Irvine and would be located adjacent to the existing LOSSAN corridor. Improvements would be made at the existing stations (Norwalk, Anaheim, and Irvine). Impacts on existing land uses along the alignment would be similar to those of conventional rail improvements along this section. The improvements proposed along the established rail route and around the existing stations appear to be compatible with existing and future land use.

Communities and Neighborhoods

Modal Alternative: The Modal Alternative would widen an existing transportation corridor around which neighborhoods and communities have been established. Since the corridor already exists, it is not expected that this alternative would divide any existing neighborhoods or otherwise substantially change the nature of the communities in the area. Improvements at the Long Beach Airport would have no impact on existing neighborhoods.

High-Speed Train Alternative: Under the HST Alternative, no new physical barrier to neighborhood interaction would be created. The existing residential areas along the alignment were developed with the railroad already in place, and the proposed HST system would not increase the barrier effect. Because the entire alignment would be grade separated, existing barriers at intersections with major cross streets would be eliminated, which would be a beneficial impact.

Property

Modal Alternative: The highest potential for property impacts due to Modal Alternative highway improvements would occur primarily in developed, urbanized areas. The LOSSAN region is primarily urbanized and consists of residential, commercial, and industrial land uses. High to medium property impacts are anticipated along I-5 from Los Angeles to San Juan Capistrano, and along I-5 from San Juan Capistrano to San Diego. The Camp Pendleton area along I-5 is undeveloped**,** and the alignment in this area would have a low property impact. There is potential for high property impacts along 59 mi (95 km) of highway alignment (28% of total highway alignment in the LOSSAN region) and potential for medium property impacts along 75 mi (121 km) of alignment (36% of total highway alignment distance in the LOSSAN region). The Lindberg Field expansion would affect 438 ac (177 ha) of high impact land uses and 10 ac (4 ha) of medium impact land uses (see Figure 3.7-15).

High-Speed Train Alternative: Under the proposed HST Alternative, no more than 2 mi (3 km) of rail alignment and station locations (1% or less of total alignment distance in the LOSSAN region) would have a high potential for property impact, and no more than 2 mi (3 km) of alignment and station locations (1% or less of alignment distance in the LOSSAN region) would have a medium potential for property impacts. The impacts would occur primarily in the vicinity of the LAX and , Anaheim sites. These impacts would be due to new alignments within this region (see Figure 3.7-16). However, because HST alignment options would use existing right-of-way, the overall potential for property impacts would be reduced.

Environmental Justice

Modal Alternative: A high percentage of minorities live within 0.25 mi (0.40 km) of I-5 in Los Angeles County. The minority population in this area is about 72%, slightly higher than the Los Angeles County average of 69%. The Modal Alternative would involve widening the existing established transportation corridor and would have low potential for impacts.

HST Alternative: The minority populations around the proposed Norwalk (UPRR corridor) and Anaheim Stations are approximately 81% and 59%, respectively. The Norwalk Station would be located along an existing rail corridor. The proposed new station at Anaheim would be underground. The potential for impacts at these stations would be low.

Minority populations were also identified in the study area along the proposed LAX to LAUS (99%) and LAUS to Irvine alignments (74%). However, the potential for impacts along these alignments would be expected to be low because the proposed alignments are along existing operating rail corridors, and because residential land uses located within 0.25 mi (0.40 km) of the rail corridor are typically buffered from the rail by non-residential uses.

Significant minority populations exist along the proposed LAUS to Irvine alignment (74%). However, the potential for impacts along these alignments would be expected to be low, because potential improvements would occur along an existing operating rail corridor, and because residential uses that are located within 0.25 mi (0.40 km) of the rail corridor are typically buffered from the rail by non-residential uses.

Figure 3.7-15
Potential Property Impacts Los Angeles to San Diego Via Orange County
Modal Alternative

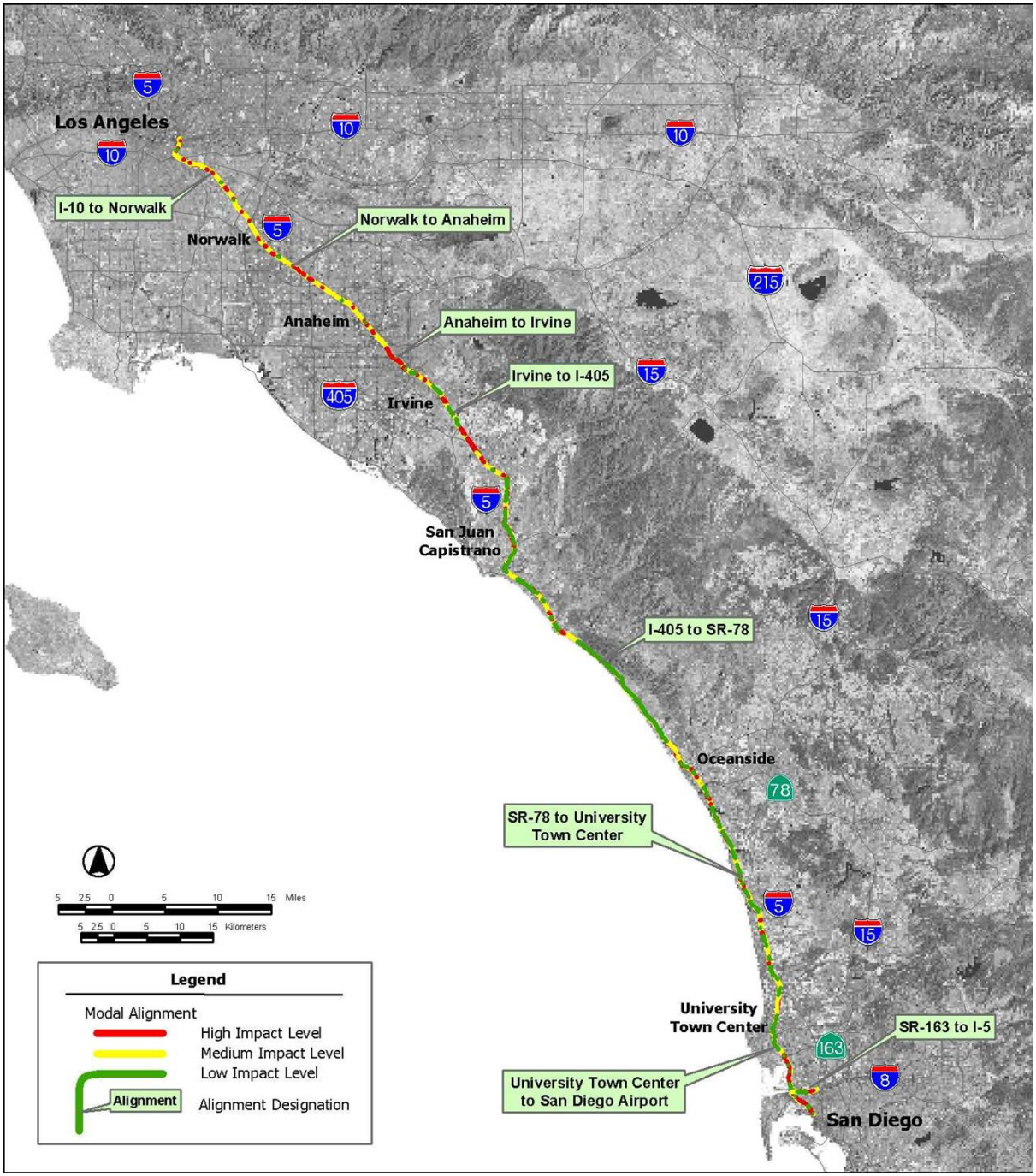
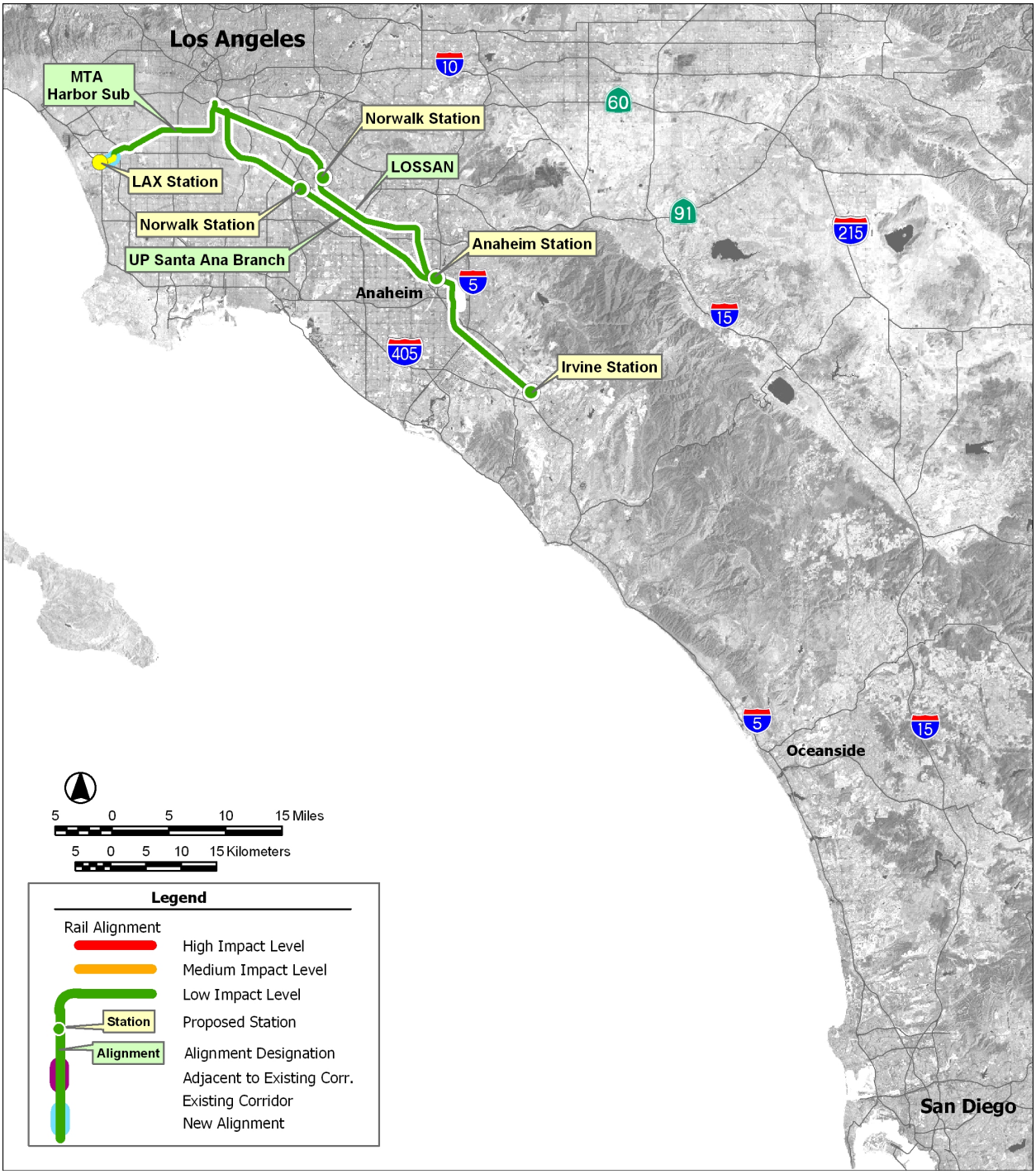


Figure 3.7-16
Potential Property Impacts Los Angeles to San Diego Via Orange County
HST Alternative



High-Speed Train Alignment Options Comparison

For the HST Alternative, the alternative routing options for high-speed rail between LAUS and Irvine present approximately the same potential for impacts related to land use. Because both options would occur within existing right-of-way, both options would have a low potential for impacts on existing land use. These impacts would be similar to those of conventional rail in this alignment. The LOSSAN corridor alignment would have higher potential connectivity and accessibility and compatibility with existing and planned development.

3.7.5 Design Practices

The Authority is committed to utilizing existing transportation corridors and rail lines in for the proposed high-speed rail system in order to minimize the need for additional rights -of -way and the associated potential property impacts. Nearly 70% percent of the adopted preferred HST alignments are either within or adjacent to a major existing transportation corridor (existing railroad or highway right-of-way). To a large extent, these existing transportation corridors already present barriers and impose other impacts on existing communities. Although the HST system would often introduce an additional (fenced) barrier, the HST systems would at least maintain and in many cases improve existing access conditions through the grade separation of existing services. Moreover, portions of the alignment would be on aerial structure or in tunnel, allowing for vehicular or pedestrian access across the alignment.

The Authority has also adopted strategies for HST stations that would incorporate transit oriented design and smart growth land use policies as described in Chapter 6B.

3.7.6 CEQA Significance Conclusions and Mitigation Strategies

Based on the analysis above, and considering the CEQA Appendix G thresholds of significance for land use and planning, the HST alternative would have a potentially significant impact on land use compatibility when viewed on a system-wide basis. While every effort has been made to incorporate alignment and station options that are compatible with existing local land use plans and ordinances to the extent feasible, in many cases local plans and ordinances do not address transportation options such as the high speed train system. In addition, many local land use plans and ordinances have not been updated for several years, and may be updated over time to acknowledge and support implementation of a high speed train system. The potential for land use incompatibility is considered significant at this programmatic level due to the uncertainties involved, however, such impacts may not be realized over the 20-year time horizon for implementing the high-speed train system. Regardless, mitigation strategies, as well as the design practices discussed in section 3.7.5, will be applied to reduce this impact, and the lead agencies will work closely with local government agencies in implementing these strategies.

The analysis in this Program EIR/EIS compares potential impacts from the alternatives and the HST alignment, station, and maintenance options. Potential impacts have been considered on a broad scale and on a system-wide basis. If a decision is made in the future to proceed with the proposed HST system, project-level review would analyze the potential for localized impacts.

A. LAND USE COMPATIBILITY

Local land use plans and ordinances would be further considered in the selection of alignments and station locations. Project-level review would consider consistency with existing and planned land use, neighborhood access needs, and multi-modal connectivity opportunities.

Potential mitigation strategies to alleviate or minimize land use related impacts associated with the HST Alternative might include, but are not limited to the following:

- Coordinate with the cities and counties in each region to ensure that project facilities would be consistent with land use planning processes and zoning ordinances.
- Establish requirements for station area plans and opportunities for transit oriented development. See Chapter 6B.

B. COMMUNITIES AND NEIGHBORHOODS

If a decision is made to go forward with the proposed HST system, alignments would be refined in consultation with local governments and planning agencies, with consideration given to minimizing barrier effects in order to maintain neighborhood integrity. Potential mitigation strategies to reduce the effects of any new barriers would be considered at the project-level environmental review and could include grade separating planned rail lines and streets, new pedestrian crossings, new cross-connection points, improved visual quality of project facilities, and traffic management plans to maintain access during and after construction.

In addition, mitigation measures would also be developed for temporary construction-related impacts on any nearby neighborhoods and communities. Potential mitigation strategies to alleviate or minimize community cohesion related impacts associated with the HST Alternative might include, but are not limited to the following:

- Provide opportunities for community involvement early in project level studies.
- Design workshops shall be held within each affected neighborhood to develop an understanding of key vehicle, bicycle, and pedestrian linkages across the rail corridor so that those linkages can be preserved, including the use of grade-separated crossings.
- Develop facility, landscape, and public art design standards for project corridors that reflect the character of adjacent affected neighborhoods.
- Ensure that connectivity (pedestrian/bicycle and vehicular crossings) across the rail corridor is maintained where necessary to maintain neighborhood integrity.
- Develop traffic management plan to reduce barrier effects during construction.
- To the extent feasible, maintain connectivity during construction.
- Maintain high level of visual quality of project facilities in neighborhood areas by implementing such measures as visual buffers, trees and other landscaping, architectural design and public artwork.

C. PROPERTY

Potential land use displacement and property acquisition (temporary use and/or permanent and non-residential property) are expected to be avoided to the extent feasible by considering further alignment adjustments and design changes in the future at the project level. In addition, analysis at the project level would consider relocation assistance in accordance with the Federal Uniform Relocation and Real Property Acquisition Policies Act of 1970. Design strategies would be developed for application at the project level to avoid or minimize the temporary or permanent acquisition of residential and non-residential property.

Access modifications including possible over or under crossings may be needed to mitigate impacts arising from partial property acquisitions that result in division of a farm or other land use.

D. ENVIRONMENTAL JUSTICE

On a system-wide basis, it is not expected that the proposed HST system would result in disproportionate adverse effects to minority or low-income populations. If a decision is made to

pursue the development of the proposed HST system, additional consideration of environmental justice issues would occur during project-level review, which would include consideration of potential localized impacts and potential benefits to and enhancements for communities along potential HST alignments. Project-level review would include consideration of detailed mitigation measures, including mitigation for temporary construction-related impacts. Project-level review would also include outreach to potentially affected communities as part of the public review process.

Potential mitigation strategies to alleviate or minimize land use related impacts associated with the HST Alternative might include, but are not limited to the following:

EO 12898 requires federal agencies to ensure effective public participation and access to information. Consequently, a key component of compliance with EO 12898 is outreach to the potentially affected minority and/or low-income population to discover issues of importance that otherwise may not be apparent. Outreach to affected communities would be conducted as part of the decision-making process, and this outreach would be documented.

In addition to examining all impacts, specific attention would be given to the permanent impact categories that are commonly of concern for this type of project and to those that previously have been identified as being of concern. These include:

- Air quality
- Noise and vibration
- Public health
- Visual/aesthetics
- Parklands
- Relocation

The above mitigation strategies are expected to reduce the land use compatibility impacts of the HST alternative to a less-than-significant level. Additional environmental assessment will allow a more precise evaluation in the second-tier, project-level environmental analyses.

3.7.7 Subsequent Analysis

Should the HST Alternative be selected, the subsequent environmental evaluations and project-level review of proposed segments and facilities would address the need for the following studies.

- Land use studies for specific alignment and station areas potentially impacted, including evaluation of potential land use conversion, potential growth, and potential community benefits.
- Review of localized potential environmental justice issues.
- Relocation impact analysis for potentially displaced housing and businesses.
- Pedestrian and vehicular circulation studies.

3.8 AGRICULTURAL LANDS

Agricultural lands considered in this environmental document are those included in the State of California Department of Conservation's Farmland Mapping and Monitoring Program (FMMP). (Government Code § 65570) FMMP-listed agricultural resource categories include prime farmland, farmland of statewide importance, unique farmland, and farmland of local importance. This section generally describes the existing farmland locations and agricultural resources in the five project regions, and identifies potential impacts related to converting farmland to non-agricultural use for each alternative and high-speed train (HST) option. Severance of farmland, insofar as it is a potential impact on a working landscape, is also discussed in this section.

3.8.1 Regulatory Requirements and Methods of Evaluation

A. REGULATORY PROVISIONS

Many regulatory and non-regulatory strategies are used to discourage farmland conversion (i.e., the conversion of land in agricultural use to non-agricultural use). In addition, there are many non-regulatory strategies used to prevent farmland conversion. CEQA provides that significant effects on the environment of agricultural land conversions be considered in the environmental review process (P.R.C. § 21060.1 and CEQA Guideline § 21095[a]).

Farmland Mapping and Monitoring Program

FMMP is the only statewide land use inventory conducted on a regular basis. California Department of Conservation administers the FMMP, under which it maintains an automated map and database system to record changes in the use of agricultural lands. Farmland under the FMMP is listed by category—prime farmland, farmland of statewide importance, unique farmland, and farmland of local importance. Information regarding locations of farmland by category is readily available. Conversely, farmland sought to be protected by various other strategies, some of which are discussed below, can be more difficult to identify because they are listed and administered locally, and may use different criteria. Because of these considerations, this document uses only the FMMP-protected farmland categories for estimating potential impacts on farmland. The farmland categories listed under the FMMP are described below. The categories are defined pursuant to U.S. Department of Agriculture (USDA) land inventory and monitoring criteria, as modified for California.

- Prime Farmland. Prime farmland is land with the best combination of physical and chemical features to sustain long-term production of agricultural crops. These lands have the soil quality, growing season, and moisture supply necessary to produce sustained high yields. Soil must meet the physical and chemical criteria determined by the USDA's Natural Resources Conservation Service (NCRS). Prime farmland must have been used for production of irrigated crops at some time during the 4 years prior to the mapping date by the FMMP.
- Farmland of Statewide Importance. Farmland of statewide importance is similar to prime farmland but with minor differences, such as greater slopes or a lesser ability of the soil to store moisture. Farmland of statewide importance must have been used for production of irrigated crops at some time during the four years prior to the mapping date.
- Unique Farmland. Unique farmland is of lesser quality soils than prime farmland or farmland of statewide importance. Unique farmland is used for the production of the state's leading agricultural crops. These lands are usually irrigated but may include non-irrigated orchards or vineyards found in some climatic zones in California. Unique farmland must have been used for crops at some time during the four years prior to the mapping date.

- Farmland of Local Importance. Farmland of local importance is farmland that is important to the local agricultural community as determined by each county's board of supervisors and local advisory committees.

Federal Farmland Protection Policy Act

The USDA's NRCS oversees the Farmland Protection Policy Act (FPPA) (7 U.S.C. § 4201 *et seq.*; see also 7 C.F.R. part 658). The FPPA (a subtitle of the 1981 Farm Bill) is national legislation designed to protect farmland. The FPPA states its purpose is to "minimize the extent to which federal programs contribute to the unnecessary conversion of farmland to nonagricultural uses." The FPPA applies to projects and programs that are sponsored or financed in whole or in part by the federal government. The FPPA does not apply to private construction projects subject to federal permitting and licensing, projects planned and completed without any assistance from a federal agency, federal projects related to national defense during a national emergency, or projects proposed on land already committed to urban development. The FPPA spells out requirements to ensure federal programs to the extent practical are compatible with state, local, and private programs and policies to protect farmland, and calls for the use of the Land Evaluation and Site Assessment (LESA) system to aid in analysis. Because the proposed HST Alternative may ultimately seek some federal funding, the FPPA is considered in this document.

Williamson Act

The California Land Conservation Act (Government Code §51200 et seq.) of 1965, commonly known as the Williamson Act, provides a tax incentive for the voluntary enrollment of agricultural and open space lands in contracts between local government and landowners. The contract enforceably restricts the land to agricultural and open space uses and compatible uses defined in state law and local ordinances. an agricultural preserve, which is established by local government, defines the boundary of an area within which a city or county will enter into contracts with landowners. Local governments calculate the property tax assessment based on the actual use of the land instead of the potential land value assuming full development.

Williamson Act contracts are for 10 years and longer. The contract is automatically renewed each year, maintaining a constant, ten-year contract, unless the landowner or local government files to initiate nonrenewal. Should that occur, the Williamson Act would terminate 10 years after the filing of a notice of nonrenewal. Only a landowner can petition for a contract cancellation. Tentative contract cancellations can only be approved after a local government makes specific findings and determines the cancellation fee to be paid by the landowner.

The State of California has the following policies regarding public acquisition and locating public improvements on lands in agricultural preserves and on lands under Williamson Act contracts (Government code §51290-51295).

- State policy to avoid location of any federal, state, or local public improvements and any improvements of public utilities, and the acquisition of land, in agricultural preserves.

- State policy to locate public improvements that are within agricultural preserves on land other than land under Williamson Act contract.

- State policy that any agency or entity proposing to locate such an improvement, in considering the relative costs of parcels of land and the development of improvements, give consideration to the value to the public of land, particularly prime agricultural land, within an agricultural preserve.

Conservation Easements

Conservation easements are voluntarily established restrictions that are permanently attached to property deeds, with the general purpose of retaining land in its natural, open-space, agricultural or other condition, while preventing uses that are deemed inconsistent with the specific conservation purposes expressed within the easements. Agricultural conservation easements define conservation purposes that are tied to keeping land available for continued use as farmland. Such farmlands remain in private ownership and the landowner retains all farmland use authority, but the farmland is restricted in its ability to be subdivided or used for non-agricultural purposes such as urban uses. The Division's California Farmland Conservancy Program (Public Resources Code §10200 et seq.) supports the voluntary granting of agricultural conservation easements from landowners to qualified non-profit organizations, such as land trusts, as well as local governments.

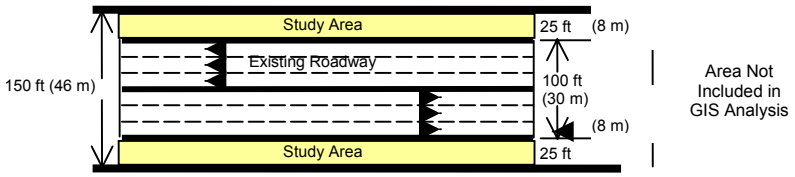
B. METHOD OF EVALUATION OF IMPACTS

Method of Determining Study Areas

Modal Alternative: It was assumed that all existing roadways potentially affected by the Modal Alternative have an average right-of-way width of 100 ft (30 m). This assumption was verified by aerial photographic analysis of the roadways that exist in agricultural areas that would be improved under the Modal Alternative. All roadway segments in the aerial photos that exceed the 100-ft (30-m) width assumption were observed to either have sufficient space to add lanes to the center portion of the roadway, or were not located near agricultural areas. The 100-ft existing roadway was excluded from geographic information systems (GIS) analysis under the assumption that no farmland impacts could occur within the right-of-way of an existing roadway.

The Modal Alternative, as defined in Chapter 2, would add one lane to each direction of travel to I-5, I-10, I-15, I-80, I-215, I-280, I-580, I-880, SR-14, SR-99, SR-152, and US-101. The Modal Alternative would also add two lanes to each direction of travel on I-5 through Los Angeles. A Caltrans standard lane width is 12 ft (3.65 m). Considering this, the study area was determined to extend from the edge of the existing right-of-way to 25 ft (8 m) on both sides of existing right-of-way. The 25-ft (8-m) distance is assumed to accommodate the added lanes with shoulders or other required additions. This approach is illustrated below in Figure 3.8-1.

Figure 3.8-1
Modal Alternative Study Area (Highways)

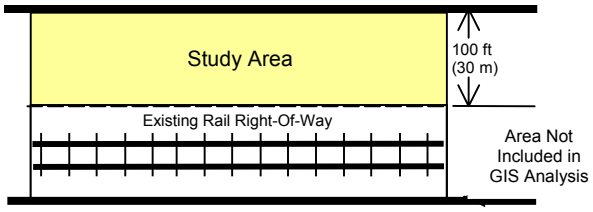


Potential farmland impacts related to the Modal Alternative airport improvements were evaluated by applying the design footprint of the facility (e.g., runway) being improved over the FMMP GIS shapefiles and calculating the impacts on the FMMP-listed farmland. The study area for the region's airports included the land required to develop the proposed improvements to runways, taxiways, and terminals. This method assumed that the potential impact was limited to the geographic extent of area needed for the improvements only, with no extra area surrounding them.

CALIFORNIA HIGH SPEED RAIL AUTHORITY
U.S. Department of Transportation Federal Railroad Administration

High-Speed Train Alternative: The study area for the HST Alternative was developed to address two different potential improvement scenarios. The first scenario was for potential alignment options adjacent to existing rail corridors. In these cases, the study area extended 100 ft (30 m) from the rail right-of-way on the side that was selected for study by the California High Speed Rail Authority (Authority) and its regional study teams based on conceptual engineering studies. This allows the development of an estimate of the area that could be needed for a proposed HST system, and an estimate within that area of the land now in agricultural use that would potentially be affected. This approach is illustrated below in Figure 3.8-2.

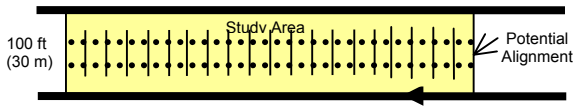
Figure 3.8-2
High-Speed Train Alternative Study Area
(in Existing Railway Areas)



This case represents a conservative approach to quantifying potential impacts, since it would be possible to fit the HST within a 50-ft (15-m) right-of-way in areas of high agricultural impact. Moreover, it may be possible to fit the entire HST line into existing rail corridors, given agreements with private rail operators. To the extent this could be done, it would reduce the potential impacts of the proposed HST Alternative to a nearly negligible level of impact on agricultural lands in existing railway areas.

The second scenario was developed for new alignments in undeveloped areas (i.e., areas outside the urban/metropolitan area that do not have existing rail rights-of-way) that are separate from existing rail corridors. In this scenario, the study area would extend 50 ft (15 m) on both sides of the proposed rail centerline, for a total width of 100 ft (30 m). This is a conservative approach because it would be possible to fit the HST line within a 50-ft (15-m) right-of-way in constrained areas. This approach is illustrated below in Figure 3.8-3.

Figure 3.8-3
High-Speed Train Alternative Study Area
(in Undeveloped Areas)



Analysis of Impacts

To ascertain the possible extent of potential farmland impacts, the Modal and HST Alternative study areas were overlain atop the FMMP farmland GIS shapefile. The GIS then calculated the acreage of farmland that would potentially be converted for the Modal Alternative improvements and the HST Alternative improvements in the study area for each of the FMMP categories. This analysis was performed for each region and used to calculate potential system-wide impacts on farmlands. This analysis accounts for proposed improvements that would expand existing transportation corridors, potential alignments that are adjacent to existing transportation corridors, and potential alignments that would traverse undeveloped areas. The station facilities

that would be included within the proposed HST Alternative are assumed to be located primarily within the study areas considered.

Improvements associated with the Modal Alternative would consist of lane additions to existing roadways, as well as additional runways, gates, and associated improvements at existing airports. Considering this, the Modal Alternative identifies improvements for specific routes as part of the overall system-wide improvement alternative. The HST Alternative represents an alternative with various alignment options within each region. While potential impacts were estimated for each alignment option, the analysis for the HST Alternative was developed to ascertain alignment combinations that would result in the least potential impacts on agricultural land per region (LPI) and alignment combinations that would result in the greatest potential impacts per region (GPI). Alignment combinations other than the LPI and GPI would be expected to have levels of impact between that of the LPI and GPI.

For purposes of this discussion, *farmland severance* is defined as the division of one farmland parcel into two or more areas of operation by the placement of a barrier (in this case rail line) through the parcel. Potential severance locations are discussed qualitatively, not quantitatively, in this program-level document. Parcel-specific information is also not considered in this program-level analysis. Project-level farmland conversion and severance impacts that are determined to be significant adverse impacts would be addressed in subsequent project-level documents.

3.8.2 Affected Environment

The locations of Modal Alternative and HST Alternative improvements in relation to the general locations of existing agricultural resources are shown in Figures 3.8-4A, 3.8-4B, 3.8-5A, and 3.8-5B.

A. STUDY AREA DEFINED

The study area for agricultural lands is defined above in Section 3.8.1 B.

B. GENERAL DISCUSSION OF AGRICULTURAL LANDS

California is the leading agricultural producer and exporter in the U.S. In 2001, California's agricultural production reached $27.6 billion, accounting for approximately 13% of the nation's gross cash receipts. The most recent statistics (2001) indicate that California has approximately 27.7 million acres (ac) (11.2 hectares [ha]) of land in farms, has approximately 88,000 farms (approximately 4% of the nation's total), and produces more than 350 different crop types. Although California has many areas of farmland production, its largest area of agricultural production is the Central Valley. Six out of the top ten California agricultural counties in 2001 were located in the Central Valley. (American Farmland Trust 2003, California Department of Food and Agriculture 2002.)

Urban growth frequently results in the conversion of agricultural land to non-agricultural uses. According to an estimate in a May 2001 report by the University of California Agricultural Issues Center, California lost approximately 497,000 ac (201,000 ha) of farmland by urbanization in the decade between 1988 and 1998, a loss rate of approximately 49,700 ac (20,100 ha) per year (Kuminoff, Sokolow, and Sumner 2001).

C. AGRICULTURAL LANDS BY REGION

<u>Bay Area to Merced</u>

This region includes central California from the San Francisco Bay Area (San Francisco and Oakland) south to the Santa Clara Valley and east across the Diablo Range to the Central Valley.

Figure 3.8-4A
Modal Alternative
North Portion of State

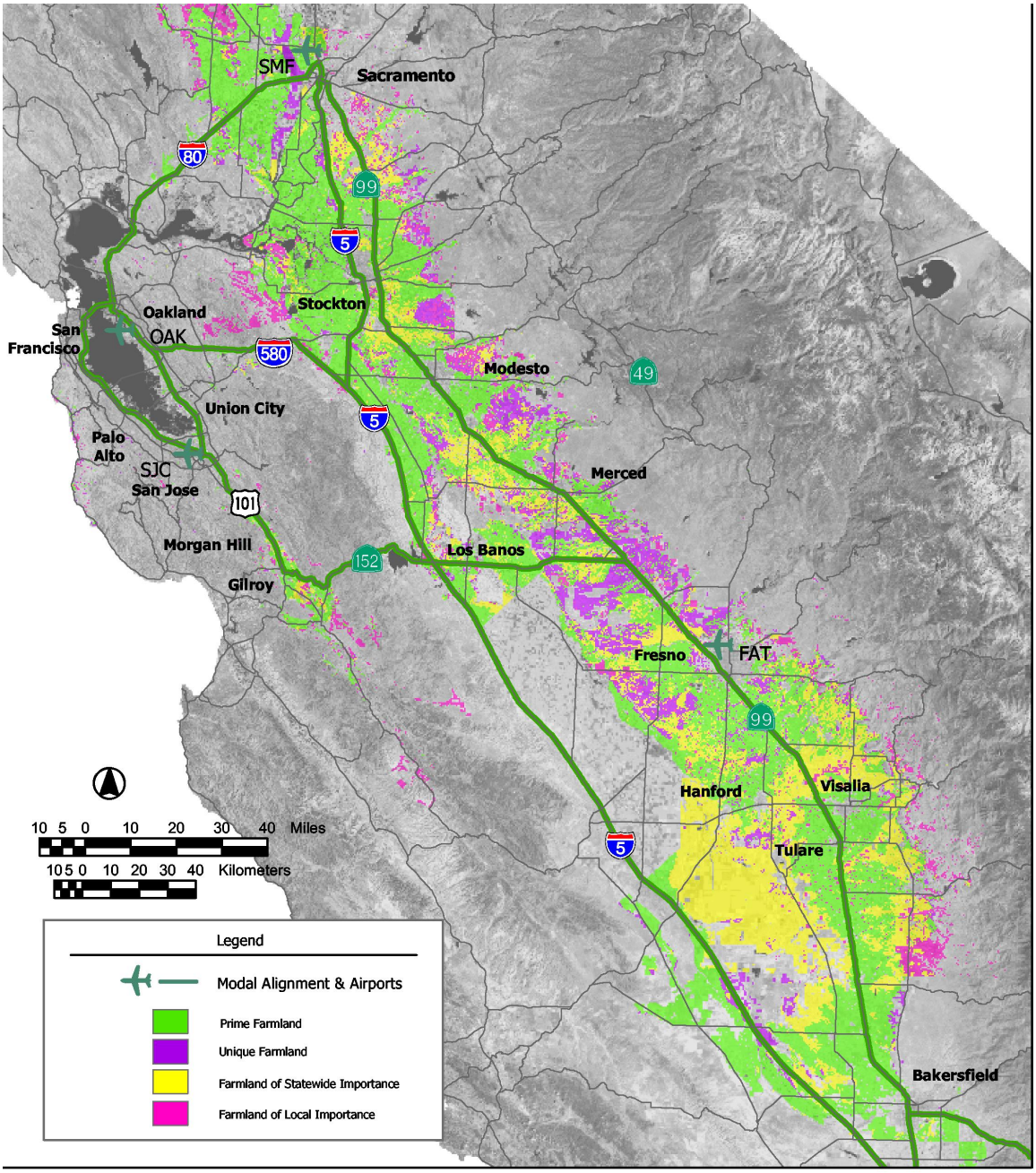


Figure 3.8-4B
Modal Alternative
South Portion of State

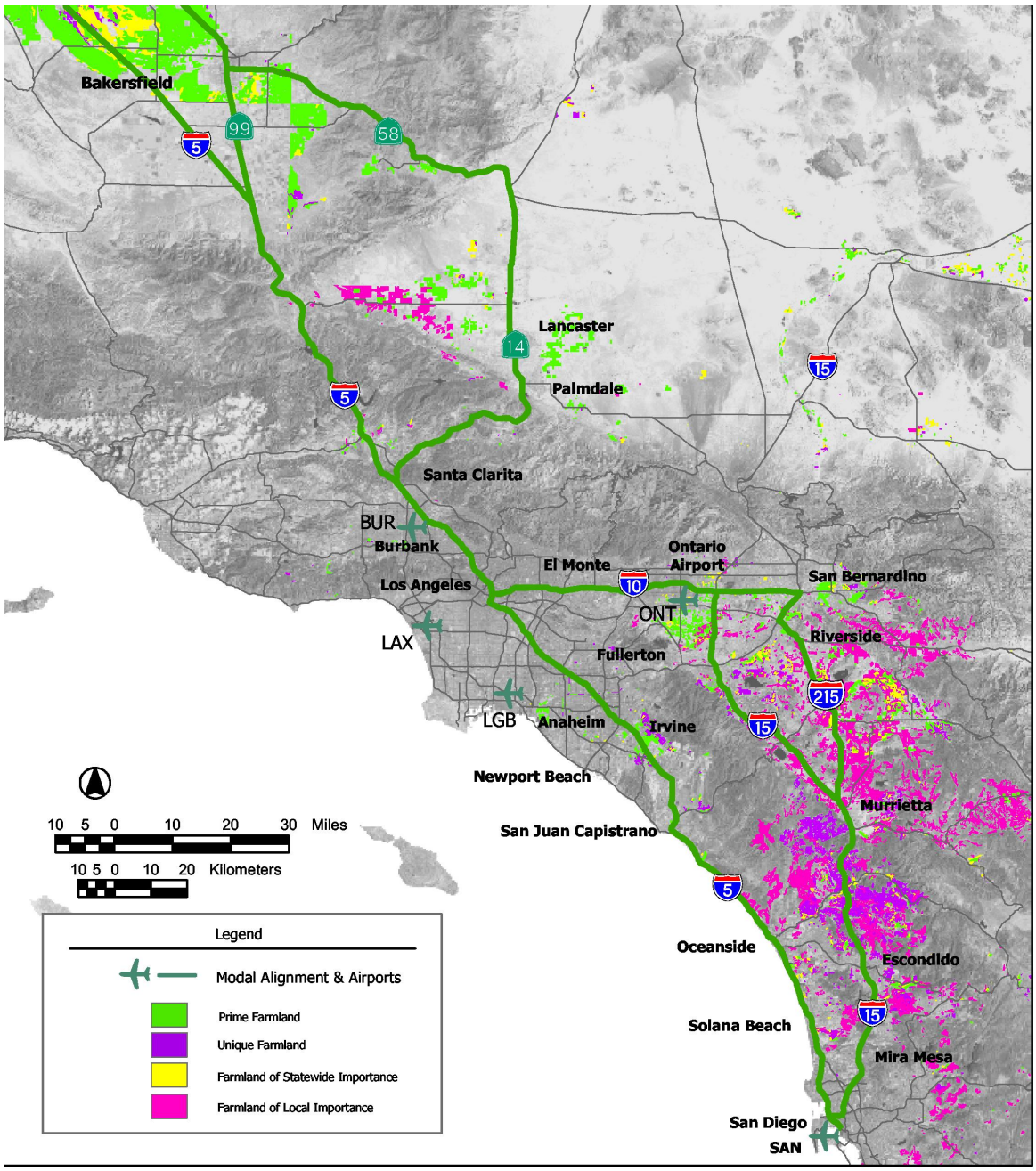


Figure 3.8-5A
High-Speed Train Alternative
North Portion of State

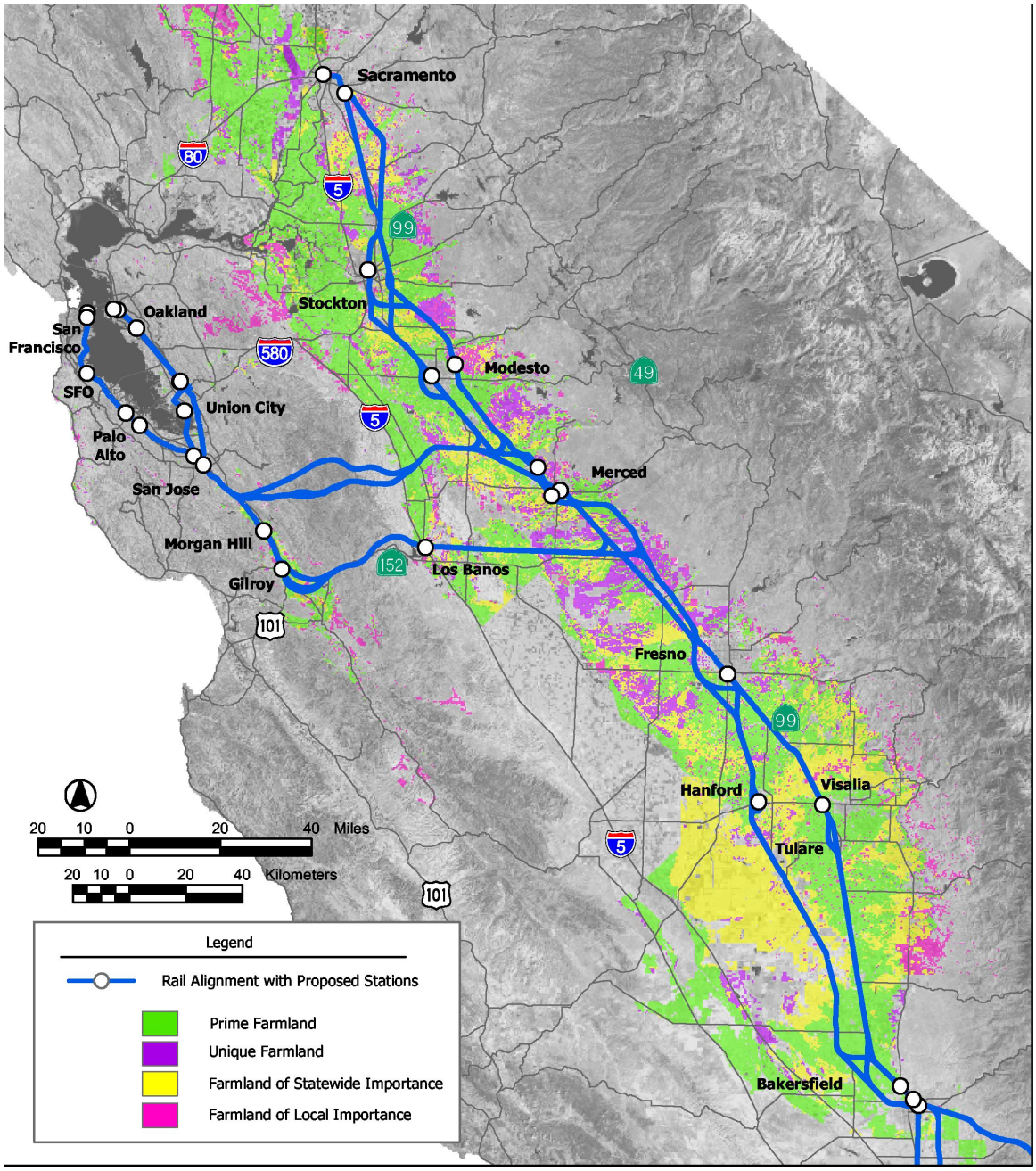
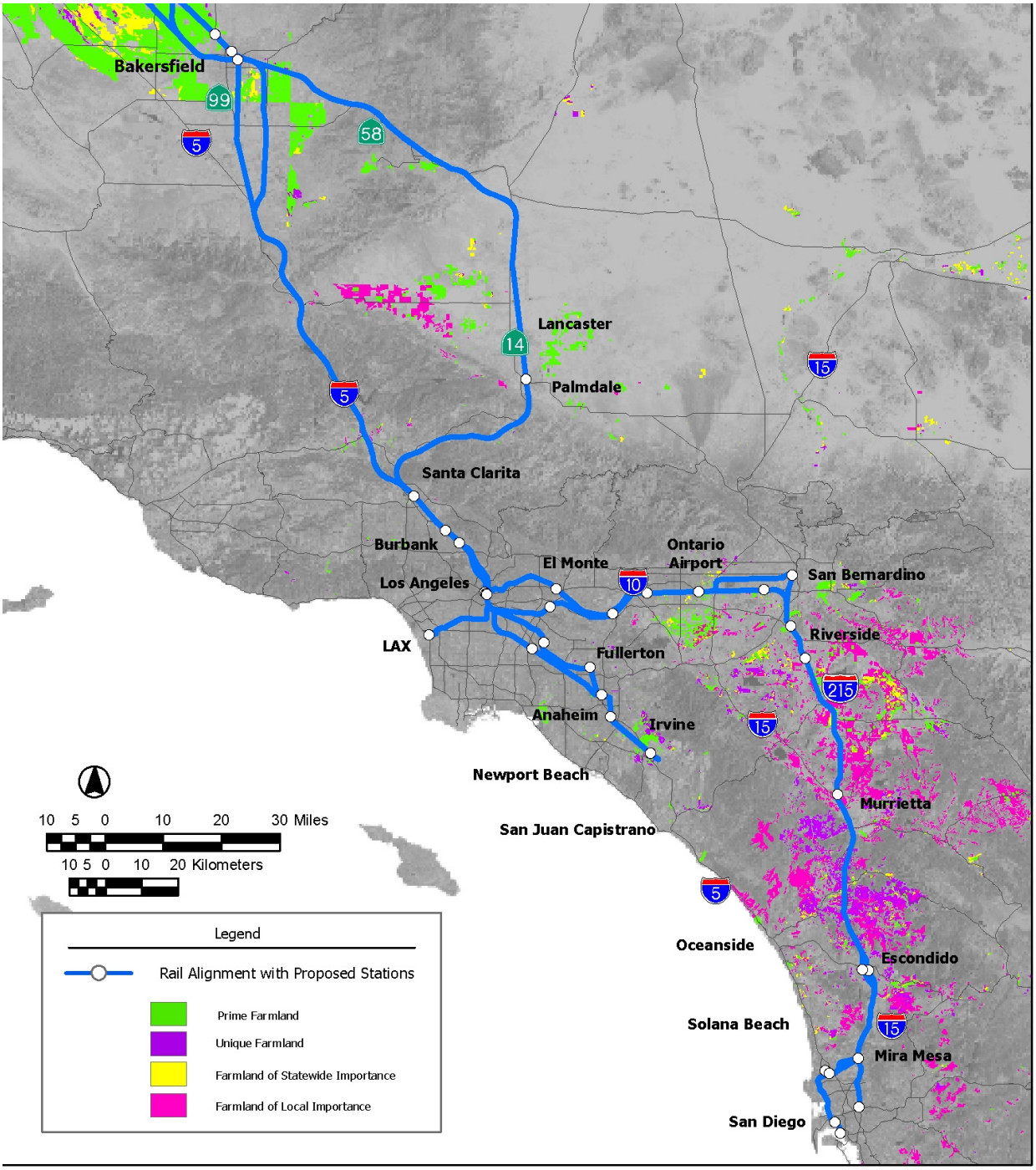


Figure 3.8-5B
High-Speed Train Alternative
South Portion of State



The majority of FMMP-listed farmland in the Bay Area to Merced region is located in the eastern portion of the region at the west side of the Central Valley. A smaller amount of FMMP-listed farmland is located in the Santa Clara Valley between San Jose and Gilroy. These areas are mostly prime farmland; smaller areas of farmland of statewide importance and farmland of local importance are also present.

Modal Alternative: The existing roadways relevant to the Modal Alternative in this region are I-80, I-580, I-880, US-101, and SR-152. I-80 travels through farmland areas in the northeastern portion of the Central Valley. I-580 (at its eastern end) travels through farmland areas in the northeastern portion of the Central Valley. I-880 travels through primarily urban areas in the eastern portion of the lower San Francisco Bay; agricultural uses are present but minimal along this roadway. US-101 travels through the agricultural areas in the southern portion of the Santa Clara Valley. SR-152 winds from the south portion of the Santa Clara Valley in an east-northeast direction to the Central Valley near the community of Los Banos. Agricultural lands along SR-152 are located in the southern portion of the Santa Clara Valley and on the eastern portion of the Central Valley.

High-Speed Train Alternative: HST Alternative alignment options in this region would begin at either San Francisco or Oakland, turn eastward at either San Jose (the Diablo Range direct alignment option) or Gilroy (the Pacheco Pass alignment option) and continue to Merced. There are negligible areas of farmland along these potential alignments between San Francisco and San Jose, and Oakland and San Jose. As indicated above, farmland in this region is primarily located in the eastern part of the region along the western areas of the Central Valley, and secondarily within the Santa Clara Valley south of San Jose. The mountainous topography along the Diablo Direct and Pacheco Pass alignment options between the Santa Clara and Central Valleys permits little agriculture besides grazing. However, grazing lands are not included in this program-level review. Grazing lands and other lands not included in the FMMP would be analyzed in the project-level review.

Sacramento to Bakersfield

This region of central California includes a large portion, approximately 75%, of the Central Valley (San Joaquin Valley) from Sacramento south to Bakersfield. The Central Valley is an active agricultural region. It contains some farmland in each of the FMMP-categories considered in this analysis. The largest FMMP farmland category represented in the Central Valley region is generally prime farmland, followed by farmland of statewide importance, then unique farmland, and, finally, farmland of local significance.

Modal Alternative: The existing roadways relevant to the Modal Alternative in this region are I-5, I-80, SR-99, and SR-152. Agricultural areas are located along the majority of the length of I-5 from Sacramento to Bakersfield. Although agricultural areas are apparent on aerial photos, the agricultural analysis is unable to ascertain agricultural impacts along I-5 in Fresno County because the FMMP has not recorded farmland for this area due to insufficient soils data. I-80 travels through the agricultural areas of the northeastern portion of the Central Valley. Like I-5, SR-99 runs through agricultural lands for the majority of its length, with minor exceptions near Fresno. SR-152 runs through areas of agriculture from I-5 to SR-99. However, agricultural uses along the Central Valley portion of SR-152 are somewhat interrupted in the area of Los Banos due to the presence of slough and pond areas. Under the Modal Alternative, the Sacramento to Bakersfield region would also include runway-related improvements to the Sacramento International Airport that would consist of lengthening Runways 1 and 2. These runways are adjacent to FMMP-listed farmland—primarily farmland of statewide importance—and some prime farmland.

High-Speed Train Alternative: Alignment options run primarily north-northwest to south-southeast adjacent to existing Union Pacific Railroad (UPRR) or Burlington Northern Santa Fe (BNSF) rail rights-of-way. There is more farmland along the BNSF corridor in this region than along the UPRR corridor. These corridors are compared below.

- Sacramento to Merced. The HST alignment options along the existing BNSF mainline corridor between Sacramento and Merced would be located within the existing Central California Traction (CCT) right-of-way from Sacramento to north of Stockton, on new alignment north of and through Stockton, and would be developed adjacent to the existing BNSF right-of-way between Stockton and Merced. The existing BNSF corridor along this length generally travels through farmland areas on exclusive right of way, circumventing the urban areas. The HST alignment options along the existing UPRR corridor are adjacent to the existing UPRR right-of-way, and would travel through more urban areas than the alignment options along the BNSF corridor. The potential alignment would include a downtown station site within Stockton. However, high-speed service through Stockton's urban area would not be feasible. The existing tracks through Stockton would need to be improved to serve stopping trains, and express tracks bypassing Stockton's urban areas would need to be developed to facilitate high-speed travel around the Stockton area. These express tracks would traverse farmland areas. The potential Modesto express loop/bypass on the UPRR mainline would run on a new alignment that would pass through farmland areas.
- Merced to Fresno. HST alignment options along the existing BNSF corridor between Merced and Fresno would travel through more agricultural areas than the alignment options along the UPRR mainline. One of the alignment options along the BNSF corridor would include new potential alignments connecting to the UPRR corridor through downtown Fresno, which corresponds to the current rail consolidation plans in this area. The new alignment of the Merced bypass, on the BNSF corridor, would travel through farmland. The Merced bypass would traverse more farmland than would the portion of the BNSF corridor that it would bypass. Options have been defined for the Merced Station on the BNSF corridor or the Merced loop/bypass. The HST potential alignment options along the existing UPRR corridor would traverse more urban areas than those on the BNSF corridor.
- Fresno to Bakersfield. HST alignment options along the existing BNSF corridor between Fresno and Bakersfield would run on new alignments in the areas around Fresno, Hanford, and just north of Bakersfield, but would be developed adjacent to existing right-of-way for the majority of the segments between these cities. An express loop/bypass along with the mainline alignment would be required around Hanford due to the existing tight curves in the area. HST alignments along the existing UPRR corridor would travel through roughly the same amount of farmland as those along the BNSF corridor. The Fresno bypass would require the development of a new alignment through farmland on the outskirts of Fresno and would run through more farmland than the existing BNSF and UPRR corridors. (The existing BNSF and UPRR corridors travel through the urban area in Fresno.)

Bakersfield to Los Angeles

This region of southern California encompasses the southern portion of the Central Valley south of Bakersfield, the mountainous areas between the Central Valley and the Los Angeles basin, and the northern portion of the Los Angeles basin from Sylmar to downtown Los Angeles. FMMP-listed agricultural land in the region is located mainly around the Bakersfield area and is largely prime farmland and farmland of statewide importance.

Modal Alternative: The existing roadways relevant to the Modal Alternative in this region are I-5, SR-99, and SR-58. I-5 travels through the agricultural areas at points south and west of Bakersfield. These areas are not included in the FMMP database and are thus not included within this agricultural analysis. South of Bakersfield, where SR-99 merges with I-5, lay the foothills of

the mountains south of the Central Valley, with fewer agricultural uses. Similar to I-5, SR-99 runs through agricultural lands south of Bakersfield. SR-58 travels through the agricultural areas south and east of Bakersfield.

High-Speed Train Alternative: The Bakersfield to Los Angeles region represents the transition from high agricultural use areas to urban areas. There is less agricultural land acreage within this area than in the Sacramento to Bakersfield region. From Bakersfield south there are two potential alignment options entering the Los Angeles area. The westernmost alignment would traverse the eastern portion of the Tehachapi Mountains, but would encounter farmland areas south of Bakersfield. The easternmost alignment would progress into the Palmdale/Lancaster area and would encounter less farmland as it travels east out of Bakersfield. Within the Los Angeles area, these alignments would join in the Sylmar area.

Los Angeles to San Diego via Inland Empire

This region of southern California includes the eastern portion of the Los Angeles basin from downtown Los Angeles east to the Riverside and San Bernardino areas and south to San Diego generally along the I-215 and I-15 corridors. FMMP-listed farmland in the region is located mainly between Lake Elsinore and Escondido, and is largely farmland of local importance and, to a lesser extent, unique farmland.

Modal Alternative: The existing roadways relevant to the Modal Alternative in this region are I-15 and I-215. I-15 travels through the agricultural areas south of Lake Elsinore, continuing to Escondido. I-215 travels through fewer agricultural areas west of Lake Perris. Also under the Modal Alternative, the Los Angeles to San Diego inland region would include runway-related improvements to the Ontario International Airport that would consist of adding a third runway. The existing runways are adjacent to FMMP-listed prime farmland.

High-Speed Train Alternative: The proposed alignment and station options in this region would progress eastward out of Los Angeles to San Bernardino and would then continue south to San Diego, encountering most of the regional farmland areas between Lake Elsinore and Escondido.

Los Angeles to San Diego via Orange County

This region includes the western portion of the Los Angeles basin between downtown Los Angeles and Los Angeles International Airport (LAX) and the areas of southern California between Los Angeles and Irvine, generally following the existing Los Angeles to San Diego via Orange County I-5 highway corridor. There is relatively little FMMP-listed agricultural land in the coastal region, and it is located between Santa Ana and Irvine. The farmland between Santa Ana and Irvine is mostly prime farmland, with a smaller area of unique farmland.

Modal Alternative: The existing roadway relevant to the Modal Alternative in this region is I-5, which travels through the agricultural areas south of Santa Ana, continuing to San Diego. FMMP-listed agricultural land along the I-5 is limited and is located between Santa Ana and Irvine, and around Oceanside. The farmland along I-5 between Santa Ana and Irvine is mostly prime farmland, with a smaller area of unique farmland. The farmland along I-5 near Oceanside is entirely farmland of local importance.

High-Speed Train Alternative: Alignment options in the LOSSAN region would primarily run through the south portion of Los Angeles County and along the central areas of Orange County. An alignment would also run from the central Los Angeles area to LAX. Considering the high urbanization of Los Angeles County and the Southern California region, very limited areas of farmland are present. The agricultural areas along the Los Angeles to Orange County alignments are primarily between Santa Ana and Irvine.

3.8.3 Environmental Consequences

A. EXISTING CONDITIONS COMPARED TO NO PROJECT ALTERNATIVE

The existing condition represents the No Project Alternative in the present and assumes the present transportation infrastructure is, and would continue to be, operational. As indicated earlier, California is presently losing farmland at a rate of 49,700 ac (20,100 ha) annually. This loss is primarily due to urban development fueled by a number of factors, including population growth, housing prices and economics, and commuting patterns (Kuminoff, Sokolow, and Sumner 2001). These circumstances suggest that there would be fewer farmland and agricultural resource areas in the future baseline case.

The No Project Alternative assumes that additional transportation improvements unrelated to this project would be programmed, funded, and expected to be operational by 2020. Some of the potential impacts on farmland from these projects would be mitigated. The trend of agricultural land conversion to accommodate urban development is likely to continue. Based on the present rate of farmland loss within the state, upon full implementation of the No Project Alternative by 2020, it is anticipated that the state would have lost nearly an additional 845,000 ac (342,000 ha) of farmland to urban development. This would represent a loss of approximately 3% of the state's 27 million ac (11 million ha) of farmland. The transportation improvements under the No Project Alternative would contribute to less than 1% of the 845,000-ac (342,000-ha) loss, but precise estimates are not possible.

B. NO PROJECT ALTERNATIVE COMPARED TO MODAL AND HIGH-SPEED TRAIN ALTERNATIVES

The No Project Alternative primarily represents planned highway improvements, with relatively minor infrastructure development. Although some farmland acquisition and conversion would likely occur under the No Project Alternative, it would be less than under the Modal or HST Alternatives because projects included in the No Project Alternative are primarily programmatic and do not require use of farmland. Table 3.8-1 provides the quantified potential impact amounts per region for the Modal and HST Alternatives.

The Modal Alternative would not create additional alignments but would expand existing infrastructure. There are various alignment options for the HST Alternative in each region.

Table 3.8-1
Impacts on Potential System-wide Agricultural Land by Alternative[a,b,c]

Alternative	Region	Prime Farmland in ac (ha)	Unique Farmland in ac (ha)	Statewide Importance in ac (ha)	Local Importance in ac (ha)	Region Totals in ac (ha)
Modal Alternative	Bay Area to Merced	168 (68)	31 (13)	56 (23)	7 (3)	262 (106)
	Sacramento to Bakersfield	323 (131)	54 (22)	181 (73)	51 (21)	609 (246)
	Bakersfield to Los Angeles	1 (0.4)	0	1 (0.4)	0	2 (0.8)
	Los Angeles to San Diego via Inland Empire	106 (43)	1 (0.4)	3 (1)	107 (43)	217 (88)
	Los Angeles to San Diego via Orange County[1]	15 (6)	4 (2)	1 (0.4)	8 (3)	28 (11)
Modal Alternative System-Wide Totals		**613 (248)**	**90 (36)**	**242 (98)**	**173 (70)**	**1,118 (452)**
HST Alternative (SWLPI)[c]	Bay Area to Merced	244 (99)	46 (19)	248 (100)	11 (4)	549 (222)
	Sacramento to Bakersfield	1,132 (458)	110 (45)	524 (212)	106 (43)	1,872 (758)
	Bakersfield to Los Angeles	0	0	0	0	0
	Los Angeles to San Diego via Inland Empire	7 (3)	0	0	17 (7)	24 (10)
	Los Angeles to Orange County	0	0	0	0	0
HST Alternative (SWLPI)[c] Totals		**1,383 (560)**	**156 (63)**	**772 (312)**	**134 (54)**	**2,445 (989)**
HST Alternative (SWGPI)[c]	Bay Area to Merced	305 (123)	175 (71)	207 (84)	83 (34)	770 (312)
	Sacramento to Bakersfield	1,532 (620)	370 (150)	868 (351)	232 (94)	3,002 (1,215)
	Bakersfield to Los Angeles	62 (25)	0	1 (0.4)	0	63 (25)
	Los Angeles to San Diego via Inland Empire	8 (3)	0	1 (0.40)	16 (7)	25 (10)
	Los Angeles to Orange County	0	0	0	0	0
HST Alternative (SWGPI)[c] Totals		**1,907 (772)**	**545 (221)**	**1,077 (436)**	**331 (134)**	**3,860 (1,562)**

[1] Modal extends to San Diego along I-5 since majority of Los Angeles to San Diego auto travel would take this route as opposed to I-215/I-15.

[a] Alternative's system-wide totals for all agricultural categories shown in bold.

[b] The SWLPI and SWGPI potential impacts are based on the conservative assumption that the HST study area for agricultural lands would be 100 ft (30 m) wide in rural areas adjacent to existing rail rights-of-way. The 100-ft (30-m) width may be reduced to 50 ft (15 m) in areas of high agricultural impact, and may further be reduced to near negligible levels should right-of-way agreements be made with the existing rail operators.

[c] The HST Alternative system-wide alignment combinations with the lowest potential impact are denoted as SWLPI. The HST Alternative system-wide alignment combinations with the greatest potential impact are denoted as SWGPI. The amounts were determined by separately adding the impact amounts of the LPI and GPI alignment combinations per region for all five regions. This was done for each FMMP category.

The results of the comparative analysis, including each of the FMMP-listed farmland categories as well as the regional category totals for each of the alternatives, support the following conclusions.

- The Modal and HST Alternatives each would result in potentially greater impacts on farmland than the No Project Alternative, with the highest potential impacts being attributable to the proposed HST Alternative system-wide alignment combinations with the greatest potential impact (SWGPI).
- Compared to the Modal Alternative, the HST Alternative would result in potentially greater impacts on farmland in two out of five regions (Sacramento to Bakersfield and Bay Area to Merced), similar impacts in one region (Bakersfield to Los Angeles), and fewer impacts in two regions (Los Angeles to San Diego via Inland Empire and LOSSAN).
- The regions with the greatest potential impacts on farmland and agricultural lands are the Bay Area to Merced and Sacramento to Bakersfield regions.
- The HST Alternative system-wide alignment combinations with the lowest potential impacts on farmland (SWLPI) would exceed the potential impacts on farmland resulting from the No Project and Modal Alternatives by 2,445 ac and 1,327 ac (989 ha and 537 ha), respectively.
- The HST Alternative SWGPI would exceed the No Project and Modal Alternatives by 3,860 ac and 2,742 ac (1,562 ha and 1,110 ha), respectively.
- The HST Alternative SWLPI could generate fewer impacts than the Modal Alternative within the farmland of local importance FMMP category.
- The HST right-of-way width could potentially be reduced to 50 ft (15 m) in the areas of impact. This reduction would reduce the HST level of impact and reduce potential differences in impacts between the HST and Modal Alternatives. The HST alignment options could fit into existing rail rights-of-way in constrained areas if agreements could be reached with existing owners/operators. This approach would reduce the potential impacts of the HST Alternative on farmland in these areas to a nearly negligible level.
- Compared to the state's potential total or overall farmland loss of nearly 845,000 ac (342,000 ha) by 2020, the Modal, HST SWLPI, and HST SWGPI Alternatives would each represent less than 0.4% of the total potential farmland loss.
- For the HST Alternative, loops/bypasses and connections on new alignments would represent greater potential impacts on farmland due to severance than the alignment options within or adjacent to existing rail rights-of-way.

3.8.4 Comparison of Alternatives by Region

Table 3.8-1 above provides a synoptic comparison of the Modal and HST Alternatives, including range (LPI and GPI) of potential impact depending on the HST alignment combinations per region and system-wide. The key findings of the agricultural lands analysis by region for the Modal Alternative and HST