3 AFFECTED ENVIRONMENT, ENVIRONMENTAL CONSEQUENCES, AND MITIGATION STRATEGIES

3.0 INTRODUCTION

This chapter addresses potential impacts to environmental resources, treating each of these resources in a separate subsection. CEQA encourages state agencies to prepare joint CEQA-NEPA documents and also encourages agencies to rely on EISs prepared for compliance with NEPA to satisfy CEQA requirements where possible and appropriate. The Co-lead agencies have used their best judgment in preparing this combined Program EIR/EIS to satisfy both CEQA and NEPA requirements, and as a result, it contains more information than that which is mandated by either the federal or State statutory and regulatory requirements. Including this information is appropriate due to the complex and unusual nature of, and the technical issues involved in, the project, the proposed HST system. While some sections in this chapter may appear to focus more on NEPA terminology than CEQA, the information and environmental analyses provided fully satisfy the requirements of both NEPA and CEQA. In addition Chapter 7 includes summary information on certain CEQA requirements discussed in this Chapter.

Each environmental area (sections of this chapter) includes potential mitigation strategies that would be applied in general for the HST system. Each subsequent section of this chapter also outlines specific design features that will be applied to the implementation of the HST system to avoid, minimize, and mitigate potential impacts.

The Authority has focused on avoiding and minimizing potential impacts through rigorous planning and thoughtful design. The Authority has minimized overall impact potential by defining alignments to stay within existing public and railroad rights-of-way to the extent feasible while still accommodating the appropriate features and design standards for the alternatives. While the Program level of environmental analysis has provided a means to avoid and minimize impacts in the selection of corridor options for further consideration, it does not identify specific impacts or mitigation. Most of the potential impacts associated with the implementation of the proposed HST system are highly site-specific in nature. These site-specific issues would be addressed during subsequent project level environmental review, based on more precise information regarding location and design of the facilities proposed (e.g., physical configuration {elevated, at-grade}, specific location, right of way footprint, catenary design features, fencing type and station access configuration, etc.). The level of engineering detail associated with the project level environmental analysis would enable the Authority to further investigate ways to avoid, minimize and mitigate potential impacts. Only after the alignment is refined and the facilities are fully defined through project level analysis, and site-specific avoidance and minimization efforts have been exhausted, would specific impacts and mitigation measures be addressed.

3.0.1 Purpose and Content of this Chapter

This purpose of this chapter is to describe existing environmental conditions in the areas that would be affected by the proposed high-speed train (HST) system and alternatives; evaluate potential environmental impacts associated with constructing and operating the HST alternative or the Modal Alternative; and present potential program-level mitigation strategies to avoid or reduce those impacts. The analysis presented in this chapter addresses the general effects of a program of actions that would make up the proposed statewide HST project. This chapter describes the general differences in potential environmental consequences between the No Project/No Action (No Project) Alternative, the Modal Alternative, and the HST Alternative. The analysis also identifies key differences between the potential impacts associated with the various HST station and alignment options, to support the selection of preferred alignment and station options for the system.

The analysis encompasses all alignment options considered for the HST alternative as described in Chapter 2. A preferred system of HST alignment options is defined in Chapter 6A, including a broad corridor for subsequent study in the northern mountain crossing.

Many sources were used in the preparation of this document. References to these sources are provided in Chapter 12. In some cases to clarify a particular source, specific references are called out in the text.

3.0.2 How this Chapter is Organized

This chapter is organized into sections by resource topic. The resource topics are grouped as follows.

- Transportation and related topics (air quality; noise and vibration; energy; and electromagnetic interference).
- Human environment (land use and community impacts; parklands; farmlands and agriculture; aesthetics and visual resources; socioeconomics; utilities and public services; and hazardous materials/wastes).
- Cultural resources (archaeological resources, historic properties) and paleontological resources.
- Natural environment (geology and seismic hazards; hydrology and water resources; and biological resources, including wetlands).
- Section 4(f) and 6(f) resources (certain types of publicly owned parklands, recreation areas, wildlife/waterfowl refuges, and historic sites).

Each resource topic section contains the following information.

- Methods of evaluation.
- Regulatory requirements.
- Affected environment.
- Environmental consequences.
- Mitigation strategies.
- Subsequent analysis.

The methods of evaluation and regulatory requirements discussions for each resource topic describe the assumptions, approach for evaluation, and rating scheme used to identify potential impacts as *significant* (potentially requiring mitigation), and identify the relevant statutes and CEQA, NEPA, or regulatory agency guidelines relevant to future project approvals or decisions for that resource area. The methods of impact evaluation were developed with input from state and federal resource agencies. The agencies acknowledged that this is a planning-level EIR/EIS aimed at making broad decisions about whether to pursue a high-speed train as a means of intercity travel in California, and if pursued, to help determine the corridors and alignments to carry forward for project-level environmental evaluation. Key differences in potential impacts for each of the alternatives are described.

As described in Chapter 2, *Alternatives*, ridership for this system was estimated to vary between 42 million passengers on the low end and 68 million passengers on the high end (10 million riders would be long-distance commuters) for 2020. For this Program EIR/EIS, the higher ridership forecast of 58 million intercity trips, together with 10 million commute trips, provides a reasonable representation of total capacity and serves as a representative worst-case scenario for analyzing the potential environmental impacts from the physical and operational aspects of the system alternatives in 2020. This higher forecast is generally used as a basis for defining the system alternatives and is referred to hereafter as the *representative demand*. In some specific analyses (e.g., energy, air quality, and

transportation), the high-end forecasts would result in potential benefits. In those cases additional analysis is included in this Program EIS/EIR to address the impacts associated with the lower ridership forecasts.

The affected environment discussions summarize the information that provides the basis for analysis of potential environmental impacts on each environmental resource. Information in the affected environment discussions is presented by study region. From north to south the five study regions are: Bay Area to Merced; Sacramento to Bakersfield; Bakersfield to Los Angeles; Los Angeles to San Diego via Inland Empire; and Los Angeles to San Diego via Orange County (LOSSAN). Because the proposed HST system would not be operational until the year 2020, the affected environment discussions describe both the existing conditions as of 2003 and, where appropriate and not overly speculative, the anticipated 2020 conditions that would pertain when the project becomes operational. For disciplines where projections of future changes in existing conditions would be overly speculative, the existing 2003 conditions were used as a proxy for the 2020 conditions. For some disciplines—such as transportation, energy, air quality, and land use—future conditions are routinely projected in adopted regional or local planning documents or are forecast by public agencies. In these cases, the existing conditions and the projected 2020 conditions were used as the basis for impact analysis. The technical studies prepared for each region and addressing each resource area provided key information for the preparation of the affected environment discussions.

The environmental consequences discussions describe the potential environmental impacts (both adverse and beneficial) of the Modal and HST Alternatives in comparison to the No Project Alternative and compared to each other. Each discussion begins by comparing existing conditions with 2020 No Project conditions to describe the consequences of No Project and how environmental conditions are expected to change during the timeframe required to bring the proposed HST system online. As described above, existing (2003) conditions were used as a proxy for 2020 No Project conditions where 2020 baseline information was unavailable, could not be projected, or would be overly speculative. Using 2020 No Project conditions as a basis for comparison, the analysis of impacts then addresses direct and indirect impacts for the proposed HST and Modal Alternatives, as well as potential cumulative impacts. Measures that already have been included as part of the proposed HST Alternative to reduce or avoid potential environmental impacts were incorporated into this analysis; examples include locating the alignment within an existing transportation corridor, and tunneling to avoid surface disruption in sensitive areas such as parklands and wildlife habitat areas. The impact analysis first compares alternatives on a system-wide basis and then compares alternatives regionally. In addition, the alignment and station options within segments of the HST Alternative are compared with one another.

The Final Program EIR/EIS analysis shows differences in both adverse and beneficial potential environmental impacts from the No Project, Modal, and HST Alternatives at the system-wide level. For many of the environmental areas, broad study areas were defined in order to provide a wide context of the existing resources in proximity to proposed improvements. For example, the area of floodplains includes all floodplains within 100 feet (ft) (30.5 meters [m]) of either side of the centerline of the alignment considered. However, the right-of-way necessary for the improvements considered is much smaller (e.g., only 25 ft [7.6 m] on either side of centerline for HST). This broader study area represents the potentially affected area. Potential impacts are reported only for a corridor width or "footprint" that represents the potential impacts of the system planned, which is assumed at 25 ft. (7.6 m) on either side of centerline (50 ft. (25 m) total width) for HST alignment options and approximately 20-40 ft. (6-12 m) on each side of existing highway facilities.

Potential impacts to public services such as traffic and circulation and utilities are addressed in the sections that follow. However, greater specificity in alignment location and profile, station designs, system access, and control systems is needed in order to be able to address the potential impacts on specific public services, such as provision of emergency personnel. These issues will be addressed during subsequent project level environmental review, when more precise information will be available regarding

location and design of the facilities proposed (e.g., elevated, at-grade, access locations, station design features, fencing type and location, etc.). The detail of engineering associated with the project level environmental analysis will allow the Authority to identify system requirements and further investigate ways to avoid, minimize and mitigate potential affects on the provision of such services.

A. DESIGN FEATURES/PRACTICES AND MITIGATION STRATEGIES

As currently planned, the preferred HST system would avoid and minimize potential negative environmental consequences of the proposed system. Conceptual designs of the preferred HST system meet the project objectives (Chapter 1: Purpose and Need and Objectives), and design criteria (Engineering Criteria Report, January 2004), which set specific goals to avoid and minimize negative environmental consequences. In addition, design and construction practices have been identified that would be employed as the project is developed further in the project specific environmental clearance, final design and construction stages. While many of these practices are explicitly included in the project description and included in the capital cost estimates for the project, their application to avoidance and minimization of potential impacts may not be readily apparent. Thus, for each environmental resource area (section of Chapter 3), applicable design and construction practices and resulting features related to the potential impacts identified in that section are discussed.

The mitigation strategies discussions describe potential mitigation approaches that can be identified at a program level for use to avoid, minimize, or reduce any potentially significant environmental impacts.

Finally, each resource topic section includes a subsequent analysis discussion summarizing directions for more detailed study during project-level environmental review and documentation should an action alternative be selected through the program environmental process.

3.1 TRAFFIC AND CIRCULATION

This section describes the existing traffic and circulation conditions in the transportation study area and identifies the potential traffic, transit, circulation, and parking impacts of each alternative and high-speed train (HST) alignment and station option.

3.1.1 Regulatory Requirements and Methods of Evaluation

A. REGULATORY REQUIREMENTS

The National Environmental Policy Act (NEPA) and California Environmental Quality (CEQA) both require that potential impacts of a proposed project on the traffic, transit, and circulation of the affected area must be examined as part of the EIR/EIS process. Under CEQA, a proposed project should be analyzed for the potential effects listed below (California Department of Transportation 2003).

- An increase in traffic that is substantial in relation to the existing traffic load and capacity of the street system (i.e., result in a substantial increase in the number of vehicle trips, the volume-to-capacity [V/C][1] ratio on roads, or congestion at intersections).
- Either individually or cumulatively exceeding a level of service (LOS)[2] standard established by the county congestion management agency for designated roads or highways.
- A substantial increase in hazards due to a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment).
- Inadequate parking capacity.
- Inadequate emergency access.
- Conflict with adopted policies, plans, or programs supporting alternative transportation (e.g., bus turnouts, bicycle racks).
- Rail, waterborne, or air traffic impacts.

V/C ratios and LOS are defined quantitatively in Table 3.1-1.

[1] The *volume-to-capacity (V/C) ratio* is the number of vehicles that travel on a transportation facility divided by the full vehicular capacity of that facility (the number of vehicles the facility was designed to convey).

[2] *Level of service* is a qualitative measure used to describe the condition of traffic flow, ranging from excellent conditions at level of service (LOS) A to overloaded conditions at LOS F. LOS D is typically recognized as an acceptable service level in urban areas. The definition for each level of service for signalized intersections is based on the V/C ratio.

Table 3.1-1
Level of Service and Volume-to-Capacity Ratio Definition

Level of Service	Volume-to-Capacity Ratio	Definition
A	0.000–0.600	EXCELLENT. No vehicle waits longer than one red light and no approach phase is fully used.
B	0.601–0.700	VERY GOOD. An occasional approach phase is fully used; many drivers begin to feel somewhat restricted within groups of vehicles.
C	0.701–0.800	GOOD. Occasionally drivers may have to wait through more than one red light; backups may develop behind turning vehicles.
D	0.801–0.900	FAIR. Delays may be substantial during portions of rush hours, but enough lower volume periods occur to permit clearing of developing lines, preventing excessive backups.
E	0.901–1.000	POOR. Represents the maximum vehicles that intersection approaches can accommodate; may be long lines of waiting vehicles through several signal cycles.
F	>1.000	FAILURE. Backups from nearby locations or on cross streets may restrict or prevent movement of vehicles out of the intersection approaches. Tremendous delays with continuously increasing queue lengths.
Source: Transportation Research Board 1980.		

Given the scale of the proposed high-speed rail system, virtually all of the criteria mentioned above would be potentially affected by the No Project, Modal, and HST Alternatives. For this analysis, this program-level document focused on the criteria below.

- Traffic and LOS analysis of the following elements.
  - Intercity highway segments.
  - Primary highways/roadways accessing proposed HST stations.
  - Primary highways/roadways accessing airports.
- Potential impacts on transit, goods movement, and parking for each of the regional corridors and proposed stations and airports.

B. METHOD OF EVALUATION OF IMPACTS

The traffic, transit, circulation, and parking analyses for this Program EIR/EIS focused on a broad comparison of potential impacts on traffic, transit, circulation, and parking along stations and around corridors for the Modal and HST Alternatives. The potential impacts for each of these alternatives were compared to the No Project Alternative.

Highway, roadways, passenger transportation services (e.g., bus, rail, air, intermodal, and transit facilities), goods movements, and parking issues were evaluated in this analysis. Transportation facilities, highways, and roadways included in the analysis serve as the primary means of existing (or planned future) access to proposed rail stations and airports. In addition, these facilities are within 1 mile (mi) (1.6 kilometers [km]) of the proposed suburban rail stations, 0.25 mi (0.40 km) of proposed downtown stations, or 1 mi (1.6 km) of airports, or are key capacity constraint points on major routes along intercity corridors.

Initial analysis included identifying primary routes to be considered, with highways designated in the No Project and Modal Alternatives, and all modes of access to the stations and airport areas in the Modal and HST Alternatives, respectively. The primary routes and modes of access for the stations and airports considered assumptions for distribution of trips by direction.

Once primary routes were identified, screenlines or cordons combining segments of the primary routes that reasonably represent locations for evaluating the aggregate baseline traffic and public passenger transportation conditions (using data for 2002, 2020, or other similar years as available) in the a.m. peak hour were selected. The use of screenlines or cordons is necessitated by the scale of this analysis with its requirement to evaluate roadway conditions throughout the state. A more detailed analytical framework must necessarily be reserved for future analyses of individual projects.

Screenlines, especially on intercity highway links, have been selected to represent typical morning peak-hour conditions. The data used in the evaluation of traffic volumes and capacities at the screenlines therefore are typical values based on averages over time and represented in traffic forecasting tools used by the regional transportation planning agencies. As such, the conditions indicated in the evaluation may not always reflect the experiences of travelers at any particular place at any specific time. For example, localized capacity restrictions (e.g., bottlenecks at a given interchange) are not well represented in those regional traffic models. In addition, incidents on the road such as accidents and vehicle breakdowns (non-recurring congestion) are not represented in regional traffic models. This unpredictable type of incident is responsible for the majority of congestion in urban highway networks. The result of these limitations of the methodology and data used in this analysis is that many times the level of service or average speed shown in the evaluation may be more optimistic than what would actually be experienced on the roadway under the forecasted conditions. Thus, it is important to consider the differences between the alternatives compared rather than focus on the absolute value of the indicators (i.e., V/C or LOS).

Baseline conditions were defined using the methodology below.

- Intercity Screenlines—Baseline conditions (2002, 2020) were established for intercity highway segments based on available counts of existing weekday morning peak-hour traffic volumes and projected annual growth rates. This process involved a comparison of existing V/C to determine LOS at link level.
- Station and Airport Cordons—Baseline (2002 and 2020 data, as available) ratios of demand to capacity across each cordon for roadways (not intersections) were established for the weekday morning peak hour using *2000 HCM* standards for capacity. (Transportation Research Board 2000.)
- Transit Access—Baseline conditions were established through an inventory of available public transportation services at and adjacent to the stations and airports.
- Goods Movement—Baseline conditions (2002, 2020) for goods movement (truck freight) weekday morning peak hour for locations in the area were identified as critical by regional goods movement studies.
- Parking near Stations and Airports—Descriptions of parking conditions are based on 2002 parking reserves, local plans for major parking expansion, and adequacy of local parking codes for meeting No Project growth in demand.

Trip generation was calculated based on the forecasted 2020 demand for high-speed rail and airports and highways improved under the Modal Alternative, the local trips in 2020 generated by project-related development (as data are available), and the additional trips due to induced growth. The generated trips were added to the appropriate baseline volumes and distributed to the identified screenlines or cordons (roadway and public transportation). Next, the generated trips were

distributed on selected segments/links on primary regional routes and modes of access to stations and similar facilities at a screenline level. Specific aspects of the methodology for this process are detailed below.

- For each screenline or cordon, new ratios of demand-to-capacity were calculated. *Demand* is the baseline volumes plus additional trip generation by the Modal or HST Alternatives.
- Future No Project link capacity conditions were established through available plans from local and regional agencies, and based on the fiscally constrained element of the relevant regional transportation plan (RTP).
- For the Modal Alternative, assumed 2020 capacity is the baseline capacity plus any improvements included in the fiscally unconstrained element of the RTP needed to mitigate potential V/C impacts. In some instances, further roadway widenings (i.e., beyond even the fiscally unconstrained RTP projects) were needed to provide capacity sufficient to meet projected traffic.
- Link-level analysis of impacts was performed to roadways for weekday morning peak-hour conditions. Capacity levels were based on the *2000 HCM* methodologies.
- Future roadway V/C on selected segments compared future volumes with/without alternatives with future capacity determined. Future V/C with/without the alternatives was analyzed. This assessment was performed at a cordon level, aggregating the V/C on all major facilities accessing the stations or airports.
- Cordon-level analysis was also performed for public transportation services serving the stations or airports, based on weekday morning peak-hour service headway and capacity conditions.
- Impacts were determined by comparing future load factors or service headway requirements with existing levels, No Project levels (as specified in relevant RTPs), and levels demanded by the Modal and HST Alternatives.
- Goods movement impacts were determined through an assessment of the net impact of project alternatives on the corridor.

Summary tables for the regions were then completed that identified impacts on highways/roadways (at screenline), public transportation services, goods movement, and parking facilities. The impacts are described and ranked as high, medium, or low in the summary tables in the appendix for this section, according to the potential extent of change to traffic, transit, circulation, and parking and described in terms of LOS A to LOS F for traffic impacts.

The final step included the identification of mitigation strategies for avoidance of potential impacts related to traffic, circulation, and parking. Most mitigation measures involve subsequent analysis of traffic, circulation, or parking in the next phase of work.

3.1.2 Affected Environment

A. STUDY AREA DEFINED

The transportation study area is defined as the primary highways and roadways that: 1) serve as the primary means of access to proposed rail stations and airport facilities, as well as the highway/roadway improvements and new facilities proposed under the Modal Alternative; and 2) are within 1.0 mi (1.6 km) of proposed rail stations and, for the Modal Alternative, airports and major routes along alignments or highway corridors.

B. GENERAL DISCUSSION OF TRAFFIC AND CIRCULATION

This analysis only considers the primary highways and roadways that serve the transportation study area. Although this level of analysis is appropriate for a program-level environmental document, variations in traffic conditions on smaller transportation facilities such as arterials and roadways are not included in the study area. Many of these smaller facilities are currently congested, and their operation is projected to worsen under the No Project Alternative. Operation on these facilities could indirectly benefit from implementation of the Modal or HST Alternative. The capacity improvements of the Modal Alternative could keep long-distance trips off local roads, while the HST Alternative could reduce demand such that long-distance trips would not be forced onto local streets. The potential impact of the proposed Modal and HST system on these smaller facilities would be examined as part of any subsequent and more detailed project-level environmental analyses.

Currently, the study area highway and roadway corridors considered in this analysis represent some of the worst traffic conditions in the nation. Highways are heavily congested during both the morning and evening peak hours in and around urban centers such as San Francisco, Sacramento, Los Angeles, and San Diego. Although the peak periods have a shorter duration, congestion affects many traditional rural and suburban communities in the Central Valley. This congestion is caused mostly by regional and urban commute traffic. Commute trips (to and from work) make up the majority of highway trips during the peak periods; the intercity trips considered in this analysis represent only a small proportion of highway traffic. The Southern California Association of Governments (SCAG) has estimated that, during morning peak-hour traffic in some of the most congested corridors in southern California, the average speed is less than 20 miles per hour (mph) (32 kilometers per hour [kph]) in the congested direction. In 2002, traffic congestion cost motorists in California $20.4 billion annually in lost time and fuel. Los Angeles and the San Francisco-Oakland area were rated as the nation's two most congested regions, and 6 out of the 25 most congested urban regions were in California (Texas Transportation Institute 2003).

Traffic conditions throughout northern and southern California are expected to worsen, and only limited improvements to transportation facilities are funded and programmed for implementation by 2020. Steadily increasing regional and urban traffic affects intercity commutes by delaying travelers where capacity is constrained. For example, according to the *Bay Area Regional Transportation Plan* (Metropolitan Transportation Commission 1999), regional travel (i.e., travel between different regions) within the Bay Area is expected to grow by 46%, and intraregional travel (i.e., travel within a region) is projected to grow by 115% by 2020. Intercity travel that competes with regional and intraregional travel for use of the same facilities is directly affected by these conditions. For instance, an intercity trip between Los Angeles and San Francisco is likely to be affected by congestion in the heavily traveled regional and intraregional travel corridors in southern and northern California, and in certain segments of the Central Valley.

C. TRAFFIC AND CIRCULATION RESOURCES BY REGION

The following section briefly describes the transportation facilities, highways, and roadways in each of the five regions analyzed.

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 primary airports in the Bay Area are San Francisco International (SFO), Oakland Metropolitan International (OAK), and Norman Y. Mineta San Jose International (SJC). As defined in Chapter 2, *Alternatives*, only OAK and SJC were considered for airport-related improvements under the Modal Alternative. The primary north-south highways in the Bay Area are US-101 and I-280 on the Peninsula, and I-880 and I-680 in the East Bay. I-80 links San Francisco and Oakland via the Bay Bridge and continues to Sacramento. I-580, I-205, and SR-152 provide access to I-5 in the

Central Valley. I-380 and SR-87 provide east-west access on the San Francisco peninsula to SFO and SJC, respectively. In the Bay Area to Merced Region, US-101, I-880, I-80, I-580, and SR-152 would undergo improvements under 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. Six airports were considered in the analysis of the Modal Alternative: Sacramento International Airport (SMF), Modesto City-County Harry Sham Field (MOD), Merced Municipal/Macready Field (MCE), Fresno Yosemite International Airport (FAT), Visalia Municipal Airport (VIS), and Bakersfield Meadows Field Airport (BFL). The Stockton Airport was not considered because of constraints that make airport expansion infeasible. Only SMF was considered for airport-related improvements. Key intercity highways in the Sacramento to Bakersfield region include I-5, SR-99, and I-80 west of Sacramento. In the Sacramento to Bakersfield region, I-5 and SR-99 would undergo improvements under the Modal Alternative.

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 Burbank-Glendale-Pasadena Airport (BUR) site was considered in the analysis of the Modal Alternative. I-5 is the primary highway link between southern California and northern California and the San Joaquin Valley. SR-14, on the west side of the San Gabriel Mountains, is the primary link between Antelope Valley, eastern California, and Los Angeles. In the Bakersfield to Los Angeles region I-5, SR-58, and SR-14 would undergo improvements under the Modal Alternative.

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. The Ontario International Airport (ONT) and San Diego International-Lindbergh Field (SAN) are the only airports potentially affected by the Modal Alternative in this region. The intercity highways in Los Angeles and Riverside Counties that could be affected by the Modal Alternative are I-10 and I-215. In San Diego County, potentially affected highways are I-15 and SR-163. In the Los Angeles to San Diego via Inland Empire region, I-10, I-15, I-215, and SR-163 would undergo improvements under the Modal Alternative.

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 Los Angeles to San Diego via Orange County (LOSSAN) rail corridor. In the LOSSAN region, I-5 and I-8 would undergo improvements under the Modal Alternative.

LAX and Long Beach Municipal Daugherty Field (LGB) are the only major commercial airports that were considered in the analysis of the Modal Alternative for the LOSSAN region. John Wayne International-Orange County Airport (SNA) in Orange County was not considered in the analysis because of constraints that make airport expansion infeasible.

A limited number of intercity highways in the region connect the three metropolitan areas of Los Angeles, Orange, and San Diego Counties. I-5 has been identified as the primary route between Los Angeles Union Station (LAUS) and San Diego. I-110 and I-105 were identified as the most direct highway links between LAUS and LAX.

3.1.3 Environmental Consequences

A. EXISTING CONDITIONS COMPARED TO NO PROJECT ALTERNATIVE

The existing condition is the transportation infrastructure that exists in 2003 and its associated levels of service. The No Project Alternative includes the existing infrastructure, plus the implementation of funded and programmed transportation improvements that will be operational by 2020 and the projected level or service of that infrastructure in 2020. Impacts on intercity highways are analyzed in terms of V/C ratio, corresponding LOS, and average highway speed. Impacts on transit, goods movement, and parking are harder to quantify but include potential impacts such as full parking lots at stations, and are assigned a low, medium, or high rating corresponding to the estimated level of potential impact.

In general, traffic conditions throughout the study area are poor in terms of congestion levels (e.g., travel delays), particularly during the peak periods. According to nationwide studies conducted by the Texas Transportation Institute, urban areas of San Francisco and Los Angeles experience some of the highest congestion levels in the country (Texas Transportation Institute 2002). Under the No Project Alternative in all regions, existing traffic conditions are projected to deteriorate on highway segments, around airports, and near the proposed HST stations in the study area. As shown in Figures 3.1-1 and 3.1-2, all of the 68 intercity highway segments analyzed, except I-580, would have a high V/C ratio under the No Project Alternative. Traffic congestion is projected to increase because travel is expected to increase by 2 to 3% per year in many areas. The No Project Alternative does not provide infrastructure improvements sufficient to address the projected growth in highway travel and the exponential increase of commute trips to both the traditional urban areas (i.e., the San Francisco Bay Area and Los Angeles basin) and the emerging urban areas in the Central Valley. In most cases, the potential impact would manifest itself as deteriorating LOS on highway segments and local streets or extended peak-period congestion on highways that already operate at LOS F (i.e., the morning peak period would extend from two hours to four hours). As summarized in Table 3.1-2, V/C ratios are projected to deteriorate by 38.4% on average across all five regions, and each region would have more LOS F segments under the No Project Alternative compared to existing conditions. The average V/C ratio would also deteriorate significantly (38.4%), which would result in more severe congestion and peak periods that last longer under the No Project Alternative compared to existing conditions.

Table 3.1-2
Summary of Existing and No Project Conditions

Intercity Highway Segments Number Operating at V/C greater than 1.0 or LOS F				
Region	**Number Analyzed**	**Existing Condition**	**No Project Condition**	**Average Change in V/C from Existing**
Bay Area to Merced	14	12	12	5%
Sacramento to Bakersfield	22	2	8	52%
Bakersfield to Los Angeles	10	5	7	73%
Los Angeles to San Diego via Inland Empire	12	7	11	43%
Los Angeles to San Diego via Orange County	10	9	8	19%
Total	68	35	38	
Average				38.4%
Source: Parsons Brinckerhoff 2003.				

Figure 3.1-1
No Project Alternative Average Change in V/C Ratios (Northern California)

Source: Landsat 1985 July 24, 2003

California High Speed Train Program EIR/EIS

Legend

Average Change in V/C Ratio

- -42 - -20 %
- -20 - 0 %
- 0 - 30 %
- 30 - 60 %
- 60 - 100 %
- 100 - 140%

10 5 0 10 20 30 Miles

105 0 10 20 30 Kilometers

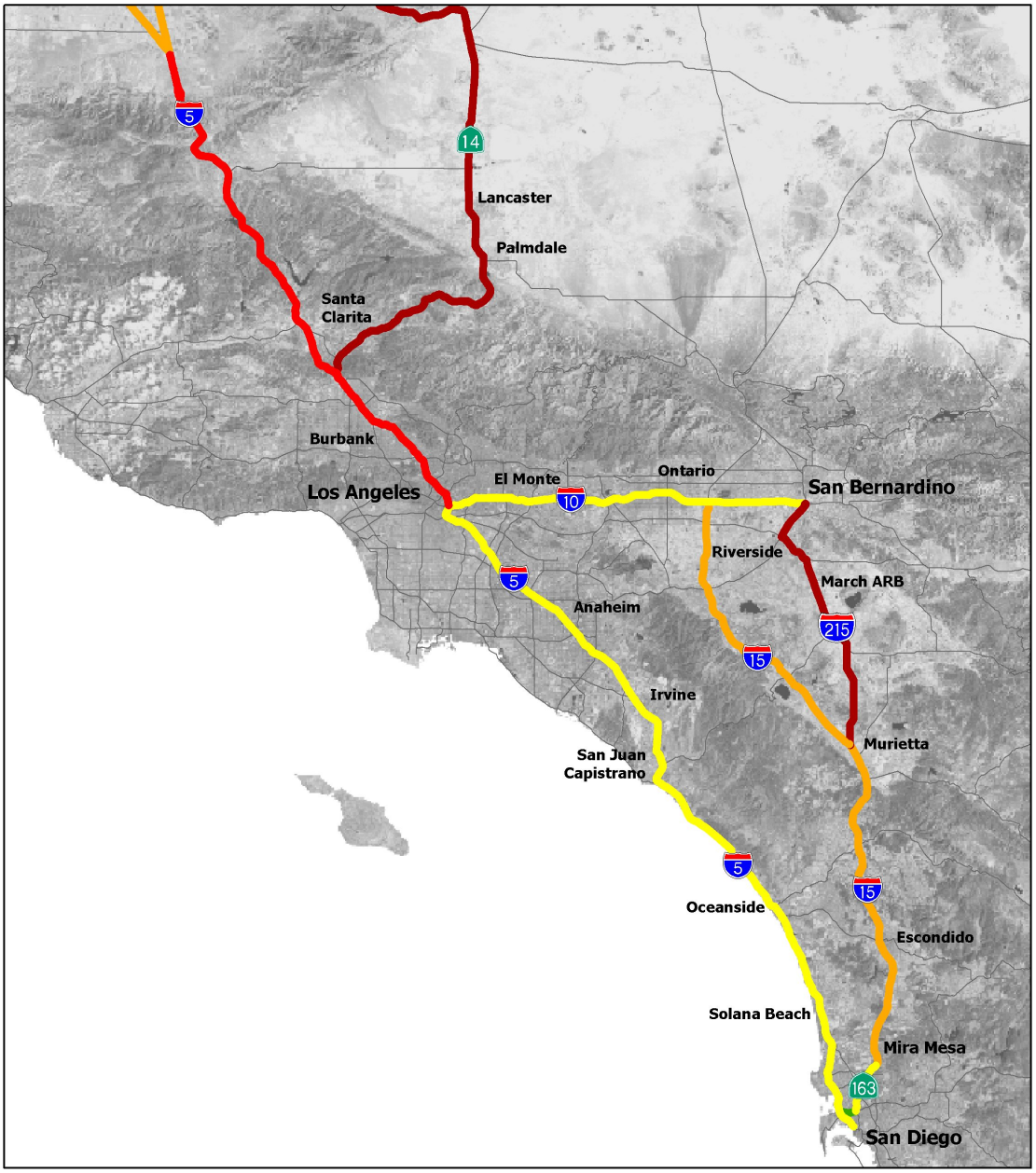
CALIFORNIA HIGH SPEED RAIL AUTHORITY

No Project/No Action Alternative
Average Change in V/C Ratios

Existing Conditions to
No Project/No Action Alternative

Northern California

Figure 3.1-2
No Project Alternative Average Change in V/C Ratios (Southern California)



Source: Landsat 1985 July 24, 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

Average Change in V/C Ratio

- -42 - -20 %
- -20 - 0 %
- 0 - 30 %
- 30 - 60 %
- 60 - 100 %
- 100 - 140%

No Project/No Action Alternative
Average Change in V/C Ratios
Existing Conditions to
No Project/No Action Alternative
Southern California

Exceptions to these projected worsening conditions are expected to occur in areas where planned highway improvements will be implemented and operational by 2020. There are only a handful of segments projected to improve between existing conditions and the No Project condition, and the projected improvements would not cause a general improvement or stabilization of conditions across the study area. Those segments that do improve are expected to eventually worsen over time as their capacity is filled by new trips attracted to the less-congested facilities.

Summary descriptions of the existing and No Project Alternative traffic, transit, circulation, and parking conditions by region are provided below. Traffic and circulation in proposed HST station areas are analyzed for the No Project Alternative, but the stations would be implemented only under the HST Alternative. For a more detailed discussion of traffic data in the five regions under existing, No Project, and the proposed Modal and HST Alternatives, see Appendix 3.1-A.

Bay Area to Merced

Intercity Highway Segments: After a decade of rapid job growth in the Bay Area, most freeway segments in the study corridors of I-80, US-101, I-880, I-580, and SR-152 are very congested, operating at LOS F in the morning peak hour in the peak direction. V/C ratios are expected to worsen on most segments under the No Project Alternative. Conditions are expected to improve only on I-880 north of San Jose and on US-101 south of San Jose, where planned highway improvements are to be implemented and operational by 2020. Overall, traffic congestion is projected to worsen because travel rates (or the number of trips taken) are increasing by 2 to 3% per year at the gateways to the Bay Area. Commute trips into the Bay Area are expected to increase by 233% between 1990 and 2020.

Proposed High-Speed Train Stations: Roadways in the study area near most of the station areas would have worse LOS under the No Project Alternative than under existing conditions. It is estimated that that LOS in 11 of the 15 station areas would deteriorate. The Millbrae Station area would show the most notable drop in LOS between 2002 and 2020 (dropping from LOS C to LOS E).

Airports: Areas within the screenlines around the San Francisco, Oakland, and San Jose airports are very congested under existing conditions, with LOS F in the peak direction of the morning peak hour. Conditions are projected to deteriorate under the No Project Alternative.

Transit, Goods Movement, and Parking: Generally, public transit and goods movement are operating under congested conditions and are not projected to change under the No Project Alternative. The only exception would be US-101 south of San Jose, where planned highway improvements would improve truck operating conditions by 2020.

Even though there is sufficient parking planned for the HST stations, one of the greatest effects that HST could have on the existing transit system would be the potential use of existing transit parking facilities by HST passengers. At all Caltrain stations other than the Millbrae Station, and at affected San Francisco Bay Area Rapid Transit District (BART) stations such as West Oakland, 12th Street, Coliseum, and Union City in the East Bay, there is sufficient parking under existing conditions. In downtown San Francisco and Oakland, as well as at the three major airports, there currently is no excess parking. Parking conditions at these locations are expected to remain the same or improve under the No Project Alternative because Caltrain and BART capital expansion programs include parking expansions and the programs are likely to continue to adjust to market demands. However, HST riders could potentially use existing transit parking facilities, resulting in parking impacts.

Sacramento to Bakersfield

Intercity Highway Segments: Under existing conditions, 4 of the 22 locations analyzed are operating at LOS E or F, while the remaining 18 locations are operating at LOS D or better. The four locations first mentioned are I-80 at the Yolo Causeway, I-5 between Hodd Franklin Road and Elk Grove Boulevard, SR-99 between Mack Road and Florin Road, and SR-99 between Collier Road and the San Joaquin/Stanislaus County line. These four worst locations are operating near capacity (V/C 0.93 or more) or over capacity (V/C 1.0 or more) along key intercity highway segments. Traffic congestion is projected to worsen on all except one of the key intercity highway segments under the No Project Alternative, even with planned highway widenings. The one exception is on I-80 at the Yolo Causeway, where planned widening of the freeway is expected to slightly improve the V/C ratio, although LOS will remain LOS F. Under the No Project Alternative, the number of locations operating at LOS E or F would increase to nine, compared to four under existing conditions. Although the remaining 13 locations would operate at LOS D or better, LOS at several of these locations would degrade by two or more ranks (e.g., from LOS B to LOS D). These locations are summarized in Table 3.1-3.

Table 3.1-3
Summary of Locations Degrading by Two or More Levels of Service under Existing and No Project Alternative Conditions Sacramento to Bakersfield Region

	Existing Conditions		No Project Alternative	
Intercity Highway Segments	**V/C**	**LOS**	**V/C**	**LOS**
I-5 north of J-11 (County Road) to Sacramento/San Joaquin County line	0.74	C	1.30	F
I-5 south of I-580	0.59	A	0.96	E
I-5 between Button Willow Rowlee and Lerdo Highway	0.43	A	0.78	C
SR-99 between Collier Road and Liberty Road	0.65	B	1.01	F
SR-99 between Hammett Road and San Joaquin/Stanislaus County line	0.82	D	1.57	F
SR-99 south of Mitchell Road	0.68	B	0.84	D
SR-99 between Adams Avenue and Clovis Avenue	0.66	B	1.03	F
SR-99 north of 7th Standard Road	0.50	A	0.74	C
SR 99 between SR-119 and Houghton Road	0.35	A	0.73	C
Source: Parsons Brinckerhoff 2003.				

Airports: Under the No Project Alternative, traffic congestion is projected to worsen at the major roadways that provide access to the Sacramento and Bakersfield Airport areas. Parking should be sufficient at the airports.

Transit, Goods Movement, and Parking: No change is projected for public transit and parking conditions under the No Project Alternative. The No Project Alternative could result in some impact on goods movement because demand would increase, but limited infrastructure improvements would be implemented.

Compared to existing conditions, no significant impacts on goods movement or parking are anticipated to occur at any of the analyzed locations under the No Project Alternative.

Bakersfield to Los Angeles

Intercity Highway Segments: The I-5 corridor is a critical transportation facility in this region and serves as the primary highway link between southern and northern California for the movement of private automobiles and trucks carrying goods. According to the California Highway Patrol (CHP), travelers on the Grapevine section of I-5 (between Gorman and Santa Clarita) experience severe weather conditions during the winter. During these severe conditions, CHP closes the Grapevine to all traffic. CHP does not record the number of closures per year, but, in general, the segment can be closed between two and eight times per year, depending on the frequency and severity of snow and ice conditions. Of the ten locations analyzed in this region, five are currently operating with severe traffic congestion (LOS F); all five of these locations are on the I-5 corridor. There are no significant capacity improvements programmed or funded for 2020 on the I-5 corridor. Therefore, under the No Project Alternative, traffic conditions are projected to worsen considerably on all of the key intercity highway segments, with eight of the ten analyzed locations projected to operate at LOS E or F. The remaining two segments (I-5 at Gorman and SR-14 Palmdale) would continue to operate at LOS A. The most notable projected LOS degradations under No Project would occur at locations listed below.

- I-5 north of SR-14 in Santa Clarita, expected to worsen from LOS C to LOS F.
- SR-14 north of Avenue P in Palmdale, expected to worsen from LOS A to LOS E.
- SR-14 north of I-5 in Santa Clarita, expected to worsen from LOS D to LOS F.

Proposed High-Speed Train Stations: Traffic conditions near all proposed HST stations are operating between LOS B and LOS E under existing conditions; however, they would all degrade to LOS F under the No Project Alternative. The most notable degradations would occur at the proposed Palmdale (LOS C to LOS F), Sylmar (LOS B to LOS F), and Burbank Downtown Station sites (LOS C to LOS F).

Airports: Under the No Project Alternative, traffic congestion would increase at the major roadways that provide access to the Burbank Airport area.

Transit, Goods Movement, and Parking: No change is projected for transit and parking conditions under the No Project Alternative. The overall potential impact on goods movement of the No Project Alternative is low.

Los Angeles to San Diego via Inland Empire

Intercity Highway Segments: Under existing conditions, the average speed on some of the region's most congested corridors is estimated to be less than 20 mph (32 kph) in the congested direction. Additionally, congestion delay is projected to increase by 100%, (Southern California Association of Governments 2003) and traffic congestion is projected to worsen on all of the key intercity highway segments, with 11 of the 12 locations analyzed projected to operate at LOS F. The most notable LOS degradations under the No Project Alternative are projected to occur at the locations listed below.

- I-15 between I-10 and I-215, expected to worsen from LOS B to LOS F.
- I-215 between I-10 and Riverside, expected to worsen from LOS A to LOS F.
- I-215 between I-15 and Temecula, expected to worsen from LOS A to LOS C.
- I-15 between Temecula and Escondido, expected to worsen from LOS B to LOS F.

Proposed High-Speed Train Stations: Traffic conditions are expected to worsen at the proposed HST station areas, with the exception of four station areas where funded roadway improvements

will occur under the No Project Alternative. These locations include the Escondido Rock Springs Station site (V/C ratio would improve from 0.72 to 0.55, LOS C would improve to LOS A), Mira Mesa Station site (0.73 to 0.71, LOS C under both conditions), Qualcomm Station site (1.17 to 0.68, LOS F to LOS B), and University Towne Centre station site (0.62 to 0.50, LOS B to LOS A).

Airports: Under the No Project Alternative, traffic congestion is projected to increase at the major roadways that provide access to the San Diego International Airport area, and traffic conditions at the Ontario International Airport are projected to improve because of roadway improvements.

Transit, Goods Movement, and Parking: No change is projected for transit and parking conditions under the No Project Alternative. Under No Project, potential impacts on goods movement would vary between low at locations such as March Air Reserve Base (ARB), Temecula, and Mira Mesa, and high at the proposed El Monte and San Bernardino HST station areas, based on observed truck volumes and surrounding land uses at these sites.

Los Angeles to San Diego via Orange County

Intercity Highway Segments: Under existing conditions, nine of the ten locations analyzed are operating at LOS F, and the remaining location (I-5 at SR-55) is operating at LOS E with a V/C ratio of 0.96, approaching LOS F (V/C of 1.0 or more). These conditions are not expected to improve under the No Project Alternative; on average, V/C ratios are projected to increase by 12% at these locations, reflecting more severe congestion and longer congested peak periods. There are two exceptions to this projected condition under the No Project Alternative: significant freeway and transit system expansions are planned along I-5 to Tamarack Avenue and along I-5 to Via De La Valle. These expansions will improve the existing LOS F condition to LOS D and E, respectively.

Proposed High-Speed Train Stations: Traffic conditions are expected to worsen at the proposed HST station sites, with the exception of four stations, where funded roadway improvements will result in improved conditions under the No Project Alternative. The proposed station sites where improvements are expected are Norwalk Station (V/C ratio would improve from 0.71 to 0.70, LOS C under both conditions), Fullerton Transit Center Station (0.84 to 0.77, LOS D to LOS C), Anaheim Transit Center Station (0.55 to 0.50, LOS A under both conditions), and University Towne Centre Station (0.68 to 0.65, LOS B under both conditions).

Airports: Under the No Project Alternative, traffic congestion would increase at the major roadways that provide access to LAX and Long Beach Airport.

Transit, Goods Movement, and Parking: Based on the existing number of transit routes, frequencies, and span of service, no significant impact on public transit services is projected (including service to LAX) if no significant improvements to existing public transit service were provided under No Project.

Most delay impacts on goods movement would occur in Los Angeles County and north Orange County, where heavy freight received at the Ports of Los Angeles and Long Beach exits the region en route to destinations throughout the nation. Potential negative impacts on goods movement in south Orange County are projected to occur because the higher vehicular traffic on I-5, which is forecast under the No Project Alternative, would not be met by a corresponding increase in the capacity of transportation facilities.

With the exception of the proposed Norwalk and Irvine Stations, no parking impacts are projected under the No Project Alternative. The Norwalk (LOSSAN) Station is projected to have medium parking impacts, and the Irvine Station is projected to have high parking impacts,

because there is little land around the station areas that can be developed to meet the projected parking demand.

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

The No Project Alternative represents the future baseline condition. It is assumed that any improvements associated with the proposed Modal or HST Alternatives would be in addition to the No Project condition. For this comparison, it is assumed that the Modal Alternative accommodates the same intercity demand, for either automobile or airplane trips, as the HST Alternative demand. It is projected that improvements associated with the proposed Modal Alternative would increase the capacity of highways (by adding traffic lanes) and airports (by adding runways and gates) to better accommodate demand compared to the No Project Alternative, and would result in improved levels of service and reduced congestion on those facilities.

As shown in Figures 3.1-3 through 3.1-6, both the proposed Modal and HST Alternatives would improve traffic at the intercity screenlines compared to the No Project Alternative. Long-term potential impacts related to the No Project Alternative would potentially be alleviated by the Modal Alternative through the addition of lane miles and airport capacity, and they would potentially be alleviated by the HST Alternative through the diversion of automobile and airplane trips to the HST. As summarized in Table 3.1-4, for the five regions the average V/C ratio improvement is anticipated to be between 14% and 33% under the Modal Alternative, and between 1% and 9% under the HST Alternative. The differences among the regions are directly related to the volume of demand. For instance, in the Sacramento to Bakersfield region under the Modal Alternative, there would be 0.70 intercity and commute (total) peak-hour trips per lane mile, a peak-hour volume of about 2,790 total highway trips over about 4,070 lane mi (6,550 km) compared to the other regions, where there would be between 2.5 (Bay Area to Merced region) and 8.1 (Bakersfield to Los Angeles region) total peak-hour trips per lane mile. Therefore, segments with less demand would experience greater changes in LOS with the proposed improvements compared to regions with higher demand. This result is illustrated by the Sacramento to Bakersfield region where, under the Modal Alternative, a 33% improvement in V/C ratio is projected, compared to a 14% to 21% change in other regions. The 14% to 33% improvement under the Modal Alternative would result from the significant improvement to highway capacity represented by 2,970 additional lane mi (4,779 km). Under the HST Alternative, 1% to 9% improvement is projected to occur, resulting from the diversion of 34 million highway trips to the HST. (No additional lane miles are included with this alternative.)

Table 3.1-4
Summary of No Project Conditions Compared to Modal and HST Alternatives

	Intercity Highway Segment Averages				
	NP	Modal Alternative		HST Alternative	
Region	V/C	V/C	% Change from NP	V/C	% Change from NP
Bay Area to Merced	1.22	0.96	21%	1.14	7%
Sacramento to Bakersfield	0.92	0.62	33%	0.89	4%
Bakersfield to Los Angeles	1.67	1.38	14%	1.67	1%
Los Angeles to San Diego via Inland Empire	1.40	1.15	19%	1.29	9%
Los Angeles to San Diego via Orange County	1.35	1.11	16%	1.31	3%
Average	1.31	1.04	21%	1.26	5%

NP = No Project Alternative.
Source: Parsons Brinckerhoff 2003.

Figure 3.1-3
Modal Alternative Average Change in V/C Ratios (Northern California)

Source: Landsat 1985 July 24, 2003

California High Speed Train Program EIR/EIS

Legend

Average Change in V/C Ratio

- -42 - -20 %
- -20 - 0 %
- 0 - 30 %
- 30 - 60 %
- 60 - 100 %
- 100 - 140%

10 5 0 10 20 30 Miles

10 5 0 10 20 30 Kilometers

CALIFORNIA HIGH SPEED RAIL AUTHORITY

Modal Alternative
Average Change in V/C Ratios

No Project/No Action Alternative
to Modal Alternative

Northern California

Figure 3.1-4
Modal Alternative Average Change in V/C Ratios (Southern California)

Source: Landsat 1985 July 24, 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

Average Change in V/C Ratio

- -42 - -20 %
- -20 - 0 %
- 0 - 30 %
- 30 - 60 %
- 60 - 100 %
- 100 - 140%

Modal Alternative
Average Change in V/C Ratios
No Project/No Action Alternative
to Modal Alternative
Southern California

Figure 3.1-5
HST Alternative Average Change in V/C Ratios (Northern California)

Source: Landsat 1985 July 24, 2003

California High Speed Train Program EIR/EIS

10 5 0 10 20 30 Miles

105 0 10 20 30 Kilometers

CALIFORNIA HIGH SPEED RAIL AUTHORITY

Legend

Average Change in V/C Ratio

- -42 - -20 %
- -20 - 0 %
- 0 - 30 %
- 30 - 60 %
- 60 - 100 %
- 100 - 140%

High Speed Rail Alternative
Average Change in V/C Ratios

No Project/No Action Alternative
to High Speed Rail Alternative

Northern California

Figure 3.1-6
HST Alternative Average Change in V/C Ratios (Southern California)

Source: Landsat 1985 July 24, 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

Average Change in V/C Ratio

- -42 - -20 %
- -20 - 0 %
- 0 - 30 %
- 30 - 60 %
- 60 - 100 %
- 100 - 140%

High Speed Rail Alternative
Average Change in V/C Ratios
No Project/No Action Alternative
to High Speed Rail Alternative
Southern California

In addition to adding capacity in discrete amounts to roadways and airports throughout the state, the Modal Alternative would provide capacity in excess of what is needed for projected intercity automobile or airplane trips, because in most cases the capacity added as part of the Modal Alternative is more than the marginal representative demand. Since highway lanes are not scaleable (i.e., it is not possible to build 25% or 50% of a highway lane to meet a 25% or 50% increase in traffic demand), most lanes added as part of the Modal Alternative have excess capacity. The traveling public is likely to respond to this new excess capacity by using the improved facilities for all trips, not just intercity trips. For example, on roadways where capacity is added, traffic congestion may well be eased, making a particular roadway a more attractive route for travel. New traffic would not necessarily be intercity traffic only, but could include shorter trips within a region. An analogous situation at airports would be one in which transcontinental or international flights make use of capacity that was added to meet intercity demand. In the case of both roadways and airports, as the forecast intercity demand is met, intercity travelers may compete for capacity with non-intercity travelers in the air and on the road. This phenomenon cannot be evaluated quantitatively at this programmatic level of analysis. Therefore, the current assessment of the Modal Alternative is possibly portraying the consequences of adding capacity to roadways and airports in terms of congestion, speeds, and level of service more optimistically and thus more favorably then actually may occur if the improvements included in the Modal Alternative were actually implemented.

The HST Alternative would reduce long-term impacts on freeways and airports by diverting intercity automobile and airplane trips to the HST system. Like the Modal Alternative, it is possible that the HST system could attract additional (induced) trips to the roadway and airports not accounted for in the Modal Alternative's highway and airport demand.

In addition to improving highway capacity by reducing traffic and reducing demand for trips to the airport, the HST Alternative would eliminate traffic delays at existing at-grade crossings along the Caltrain corridor in the Bay Area and at other select crossings throughout the state. This reduction in delay was measured by estimating the daily vehicle delay savings (i.e., the reduction in the number of hours spent sitting waiting at grade crossings) that would be achieved through grade separation at six sample crossings along the Caltrain shared-use corridor. The four- and six-lane arterial streets were projected to have average daily traffic (ADT) ranging from about 15,000 to 40,000 vehicles in 2020. Grade separations proposed for the HST Alternative resulted in a delay savings from about 10 vehicle hours per day at the lowest volumes to almost 200 vehicle hours per day at the highest volumes. The grade separations would also improve the reliability of both the vehicle trips crossing the HST corridors and the existing commuter conventional intercity rail and freight trips within the corridors. There will also be potential for closures (both permanent and temporary) of minor streets, where grade separation is not deemed necessary due to low traffic volumes and access requirements.

Overall, as summarized in Table 3.1-4, although highway conditions would improve under the Modal and HST Alternatives, the general conditions would remain at poor LOS with V/C ratios of more than 1.0 on average for each of the five regions. As discussed above, the conditions shown in the evaluation may not always reflect the experiences of travelers at any particular place at any specific time. For example, localized capacity restrictions (e.g., bottlenecks at a given interchange) are not well represented in regional traffic models. In addition, incidents on the road, such as accidents and vehicle breakdowns, are not represented in the regional traffic models. These non-recurring incidents are unpredictable and are responsible for the majority of congestion on urban highway networks.

Goods movement and transit have some minor regional or local impacts; however, on a statewide basis, the potential effects of the Modal and HST Alternatives would be negligible. Planning provisions were made for parking at airports and station areas under the Modal and HST Alternatives respectively; consequently, there should be little effect on the existing parking supplies.

3.1.4 Comparison of Alternatives by Region

This section summarizes key findings comparing the Modal and HST Alternatives to the No Project Alternative, and to each other by region, based on traffic, circulation, and parking. For detailed summary tables associated with this analysis, see Appendix 3.1-A.

A. BAY AREA TO MERCED

Modal Alternative

Intercity Highway Segments: The number of segments operating at LOS F would decrease from 12 under the No Project Alternative to 7 under the Modal Alternative, and the V/C ratios along these segments would improve by 15% on average (Table 3.1-5). The most substantial improvement compared to the No Project Alternative would occur along SR-152 between I-5 and SR-99, where the LOS would improve from LOS F to LOS A, and the V/C ratio would decrease by 50%, from 1.21 to 0.60.

Table 3.1-5
Segments Operating at LOS F (V/C Higher than 1.0)
Bay Area to Merced

Alternative	Number of Segments	V/C % Change
No Project[a]	12	6%
Modal[b]	7	-15%
HST[b]	11	-4.7%

[a] Compared to existing conditions.
[b] Compared to No Project Alternative.
Source: Parsons Brinckerhoff 2003.

Proposed High-Speed Train Stations: The LOS and V/C ratios in the vicinity of the 15 proposed HST station areas are not projected to change under the Modal Alternative compared to the No Project Alternative. As noted in the *Existing Conditions Compared to No Project Alternative* section above, traffic and circulation in proposed HST station areas are analyzed for the Modal Alternative, but the stations would be implemented only under the HST Alternative.

Airports: It was assumed that capacity improvements would be made at OAK and SJC under the Modal Alternative. Freeway links and access roads accessing SJC are estimated to improve from LOS F to LOS E compared to the No Project Alternative because of the proposed capacity improvements in the area.

Transit, Goods Movement, and Parking: The Modal Alternative is not projected to have any potential impact on public transit conditions compared to the No Project Alternative because there are no planned increases in transit services under the Modal Alternative. The Modal Alternative is projected to improve goods movement compared to the No Project and HST Alternatives because the proposed highway capacity improvements would reduce congestion and improve truck travel times.

In general, the Modal Alternative would not affect parking near proposed station and airport areas, and it is assumed there would be no change compared to the No Project Alternative.

High-Speed Train Alternative

Intercity Highway Segments: The number of segments operating at LOS F would decrease from 12 under the No Project Alternative to 11 under the HST Alternative, and the V/C ratios along the

segments would improve by approximately 5% on average (Table 3.1-5). The most substantial improvement under the HST Alternative compared to the No Project Alternative would occur along US-101 between San Francisco and SFO, where the LOS would improve from LOS F to LOS C, and the V/C ratio would decrease by 33%, from 1.06 to 0.71. This significant improvement would result from the additional lane capacity from diversion of automobile trips to HST and the reduction in trips to SFO during the peak period because of the diversion of air travelers to the HST system.

Proposed High-Speed Train Stations: The only significant projected degradation under the HST Alternative compared to the No Project Alternative would occur at the proposed Transbay Terminal, where the LOS would degrade from LOS D to LOS F, and the V/C ratio would increase from 0.89 to 1.01 because substantially more trips would be attracted to the facility.

Airports: LOS on freeway links accessing SFO would improve from LOS F to LOS E under the HST Alternative compared to the No Project Alternative because air travelers would be diverted to the HST system.

Transit, Goods Movement, and Parking: The HST Alternative is not projected to have any potential impact on public transit conditions compared to the No Project Alternative. The HST Alternative is not projected to have any impact on goods movement. Assuming that the HST Alternative would provide parking at all station areas except in downtown San Francisco and Oakland, parking conditions under the HST Alternative would be similar to those under the No Project and Modal Alternatives.

High-Speed Train Alignment Option Comparison

The two Pacheco Pass alignment options listed below would affect US-101 traffic south of San Jose.

- Morgan Hill/Caltrain/Pacheco Pass alignment.
- Caltrain/Gilroy/Pacheco Pass alignment.

The single option below would affect I-880 traffic north of Fremont/Newark.

- Hayward alignment/I-880.

If the Gilroy bypass option were implemented instead of the Gilroy option, a station is proposed in Morgan Hill instead of Gilroy, with the result that some Gilroy traffic would have to travel north on US-101 to reach the Morgan Hill Station. This outcome would increase traffic on US-101 in Gilroy by about 4%, lowering speeds by less than 1 mph (1.6 kph). The LOS on US-101 would remain LOS B in the morning peak direction, and LOS A in the morning off-peak direction.

If one of the Diablo Range Direct alignment options were implemented, there would be no stations at Los Banos, Gilroy, or Morgan Hill. Traffic in Gilroy would be the same as under the Gilroy bypass option. Traffic on US-101 south of SR-85 would increase by approximately 1% with no change in LOS.

If the Hayward/Niles/Mulford Line option were implemented and the Auto Mall Station were chosen instead of the Union City Station, traffic would increase by approximately 2% on I-880 north of SR-4 with no change in LOS.

Traffic impacts would be more severe in the potential Transbay Terminal area than in the 4th and King Street Station area. This difference would be partly caused by the congestion levels

anticipated for all streets near the Transbay Terminal. In contrast, the major effects at 4th and King Streets would be concentrated on King Street. The impact at the Transbay Terminal may potentially be counteracted by high usage of transit in the downtown San Francisco area.

B. SACRAMENTO TO BAKERSFIELD

Modal Alternative

Intercity Highway Segments: The number of segments operating at LOS F would decrease from seven under the No Project Alternative to two under the Modal Alternative, and the V/C ratios along these segments would improve by 34% on average, as shown in Table 3.1-6. This region would experience the largest change in LOS because it has the lowest volume of demand per lane mile compared to the other regions. The most substantial improvement compared to the No Project Alternative would occur along SR-99 between Collier Road and Liberty Road, where the LOS would improve from LOS F to LOS A, and the V/C ratio would decrease by 42%, from 1.01 to 0.58.

Table 3.1-6
Segments Operating at LOS F (V/C Higher than 1.0)
Sacramento to Bakersfield

Alternative	Number of Segments	V/C % Change
No Project[a]	7	51%
Modal[b]	2	-34%
HST[b]	7	-1.5%

[a] Compared to existing conditions.
[b] Compared to No Project Alternative.
Source: Parsons Brinckerhoff 2003.

Proposed High-Speed Train Stations: The LOS and V/C ratios at the 14 proposed HST station areas in the region are not projected to change under the Modal Alternative compared to the No Project Alternative.

Airports: It was assumed that capacity improvements would be made at Sacramento, Fresno, and Bakersfield airports under the Modal Alternative. There would be no significant change in the LOS or V/C ratios within the airport areas compared to the No Project Alternative.

Transit, Goods Movement, and Parking: The Modal Alternative is not expected to have any substantial potential impact on transit services compared to the No Project Alternative. The Modal Alternative could have a positive effect on goods movement due to the improvements in LOS. The Modal Alternative would not generally affect parking near proposed station and airport areas, and it is assumed there would be no change compared to the No Project Alternative.

High-Speed Train Alternative

Intercity Highway Segments: Under the HST Alternative, there would be no change in the number and location of segments operating at LOS F compared to the No Project Alternative. However, there would be an approximate 2% improvement in V/C ratios on average (Table 3.1-6). The most substantial V/C ratio improvement (13%) would occur on I-5 between SR-165 and the Merced/Fresno County line. The LOS along this segment would remain LOS A.

Proposed High-Speed Train Stations: The LOS and V/C ratios at the 14 proposed HST station areas are not projected to change under the HST Alternative compared to the No Project Alternative.

Airports: Compared to the No Project Alternative, the HST Alternative would improve traffic conditions at SMF from LOS D to LOS B and would reduce the V/C ratio by 28%, from 0.88 to 0.63. Although the HST Alternative would improve conditions near the Bakersfield airport from a V/C ratio of 1.09 to 1.05, this improvement would not be substantial enough to improve service to LOS E or better.

Transit, Goods Movement, and Parking: The HST Alternative is not expected to have any substantial impact on transit services compared to the No Project Alternative.

Considering all alignment options where HST tracks are proposed to be at grade and adjacent to existing freight and passenger tracks, as many as 258 locations would be grade-separated from roadway traffic under the HST Alternative. Each of these grade separations would reduce conflicts between rail and highway traffic, thereby improving the efficiency and safety of both modes. The exact number of locations at which crossing roadways would be grade-separated from rail tracks would depend on the final specific HST alignments chosen for the region.

The HST Alternative would be planned to provide an adequate supply of parking at HST stations; therefore, compared to the No Project Alternative, no parking impacts are expected under the HST Alternative.

High-Speed Train Alignment Option Comparison
The major alignment and station options in this region are alternative station locations.

- In Sacramento, a station in downtown Sacramento or on Power Inn Road.
- In Modesto, a station in downtown Modesto or on Briggsmore.
- In Merced, a station at the municipal airport, in downtown Merced, or at Castle Air Force Base (AFB).
- In Bakersfield, a station at the airport, on Golden State, or on Truxtun.

Because of relatively low volumes of demand, the choice of stations would cause no significant differences in aggregate roadway LOS between the HST Alternative and the No Project Alternative. There would be no change in the LOS in all instances, although the V/C ratio may be slightly higher under the HST Alternative.

With respect to transit, the Power Inn Road and Bakersfield Airport Station options would require the addition of transit services. Direct connection to Amtrak service would be available only at the downtown Sacramento, Briggsmore, downtown Merced, and Truxtun Stations.

As noted above with respect to goods movement, the proposed HST system would not affect future goods movement and consequently it is not possible at this level of analysis to distinguish between the design options. With respect to parking, the only significant difference among station options would occur in Sacramento, where the Power Inn Road option would require 1,200 (or 69%) more new parking spaces than the downtown Sacramento option.

C. BAKERSFIELD TO LOS ANGELES

Modal Alternative
Intercity Highway Segments: Under the Modal Alternative, there would be no change in the number and location of segments operating at LOS F compared to the No Project Alternative. However, V/C ratios along these LOS F segments would improve an average of approximately 17%, as shown in Table 3.1-7. The most substantial improvement in V/C ratio compared to the

No Project Alternative (27%) would occur on I-5 near Burbank; however, the LOS along this segment would remain LOS F.

Table 3.1-7
Segments Operating at LOS F (V/C Higher than 1.0)
Bakersfield to Los Angeles

Alternative	Number of Segments	V/C % Change
No Project[a]	7	73%
Modal[b]	7	-17%
HST[b]	7	0.7%

[a] Compared to existing conditions.
[b] Compared to No Project Alternative.
Source: Parsons Brinckerhoff 2003.

Proposed High-Speed Train Stations: All five of the proposed HST station areas would remain LOS F under the Modal Alternative, and there would be no significant change in V/C ratios compared to the No Project Alternative.

Airports: It was assumed that additional runway and gate capacity improvements would be made at BUR under the Modal Alternative. Although the demand of the Modal Alternative would result in increased traffic in and around BUR, the V/C ratio would decrease by 14% because of planned highway improvements that will be implemented under the No Project Alternative.

Transit, Goods Movement, and Parking: The Modal Alternative is not expected to have significant impacts on public transit, goods movement, or parking compared to the No Project Alternative.

High-Speed Train Alternative

Intercity Highway Segments: Under the HST Alternative, there would be no change in the number and location of segments operating at LOS F compared to the No Project Alternative, and there would be no significant change in V/C ratios.

Proposed High-Speed Train Stations: Within each of the five proposed station areas, there would be an increase in traffic. V/C ratios would increase compared to the No Project Alternative by an average of about 4%, and level of service would remain LOS F. The most substantial impact would occur at the Burbank Downtown Station, where the V/C ratio would increase by 7%.

Airports: The HST Alternative would cause no significant change in the levels of service or V/C ratios in the Burbank airport area, compared to No Project.

Transit, Goods Movement, and Parking: The HST Alternative is expected to improve goods movement by grade separating many Metrolink and freight crossings that would be at grade under the No Project Alternative. This outcome would positively affect both train operations that use the grade separation and bus operations that are currently delayed at grade crossings.

Under the HST Alternative, the impact on parking at the Palmdale Station is assumed to be low because land is available for creating parking facilities in the immediate vicinity of the proposed station. The impacts on parking at Sylmar and Burbank Downtown Stations are rated medium because these locations are currently stations on the existing Metrolink commuter rail system, and there is some potential for parking to spill over from the HST into the existing parking lots. It is assumed that parking sufficient to meet the forecast HST ridership demand would be provided in new or expanded parking structures at both locations. The impact on parking is

rated low at LAUS because major multilevel parking structures would be constructed in downtown Los Angeles to accommodate the HST parking demand in conjunction with station development.

High-Speed Train Alignment Option Comparison

The Bakersfield to Sylmar HST alignment options that roughly follow I-5 and SR-58 are the two principal alignment options in this region. If the SR-58/Soledad Canyon option were chosen, there would be a station in Palmdale. In Palmdale, the SR-58/Soledad Canyon HST option would only slightly increase the aggregate V/C ratio (from 1.20 to 1.22) in the study area, primarily on roads that provide direct access to the station. If the I-5 option were chosen, there would not be a station in Palmdale. Traffic analyses that incorporate the I-5 and SR-58 alignments show no significant difference between the two options.

Other design options are listed below.

- In Burbank, a station at Burbank airport or a station in downtown Burbank.
- Near LAUS, a station south of LAUS above the Los Angeles River or a station on the east bank of the Los Angeles River.

In Burbank, most of the roadways providing access to the alternative station areas are forecast to operate above capacity (i.e., LOS F) with or without the HST Alternative. For the airport option, the HST Alternative would increase the aggregate roadway V/C ratio by 2%; for the downtown option, the projected increase would be 7%. An airport station would provide better access to air service; a downtown Burbank station would be located closer to the midpoint between Sylmar and LAUS and would provide better access to Metrolink commuter trains.

At LAUS, either design option would include new parking on both sides of the Los Angeles River and would require a people-mover link to LAUS. The southern option would increase traffic on already congested (LOS F) Alameda Street, whereas the east bank option would add traffic to Mission Road, which is not a primary access street for the station currently and would need widening and upgrading.

D. LOS ANGELES TO SAN DIEGO VIA INLAND EMPIRE

Modal Alternative

Intercity Highway Segments: Under the Modal Alternative, only the I-15 segment between Temecula and Escondido would show an improvement in LOS, from LOS F to LOS E, compared to the No Project Alternative. As shown in Table 3.1-8, the average V/C improvement would be approximately 17%. The potentially most substantial improvement compared to the No Project Alternative would occur along I-215 between I-15 and Temecula, where the V/C ratio would decrease by 33% and the LOS would improve from LOS C to LOS A.

Table 3.1-8
Segments Operating at LOS F (V/C Higher than 1.0)
Los Angeles to San Diego via Inland Empire

Alternative	Number of Segments	V/C % Change
No Project[a]	11	43%
Modal[b]	10	-17.4%
HST[b]	10	-7.2%

[a] Compared to existing conditions.
[b] Compared to No Project Alternative.
Source: Parsons Brinckerhoff 2003.

Proposed High-Speed Train Stations: No changes in traffic conditions around HST stations are expected to occur under the Modal Alternative compared to the No Project Alternative.

Airports: Under the Modal Alternative, capacity improvements are planned at the San Diego airport and Ontario. Compared to the No Project Alternative, the level of service at San Diego airport street screenlines is expected to deteriorate as follows: Pacific Highway (LOS A to LOS F), Laurel Street (LOS E to LOS F), Hawthorn Street (LOS D to LOS F), and North Harbor Drive (LOS A to LOS B). There are no significant impacts expected in the area of the Ontario airport.

Transit, Goods Movement, and Parking: There is little differentiation in potential transit and goods movement impacts between the No Project, Modal, and HST Alternatives. The Modal Alternative would have slightly more impacts on parking at the Ontario and San Diego airports than the HST or No Project Alternatives.

High-Speed Train Alternative

Intercity Highway Segments: Overall, the HST Alternative would improve V/C ratios by an average of approximately 7% compared to the No Project Alternative. As under the Modal Alternative, only the I-15 segment between Temecula and Escondido would show an improvement in LOS (from LOS F to LOS E) compared to the No Project Alternative. This segment would also potentially show the most substantial change in V/C ratio: a 19% improvement, from 1.16 to 0.94.

Proposed High-Speed Train Stations: Compared to the No Project Alternative, traffic conditions around the 17 proposed HST stations would potentially deteriorate as follows: South El Monte (LOS B to LOS C), Qualcomm (LOS B to LOS C), Escondido Transit Center (LOS D to LOS E) and San Diego International Airport (LOS C to LOS E).

Airports: Compared to the No Project Alternative, the HST Alternative would cause no significant change in levels of service or V/C ratios in the airport areas.

Transit, Goods Movement, and Parking: There is little differentiation in potential impacts between transit, goods movement, and parking between the No-Project, Modal, and HST Alternatives.

In the proposed HST station areas, the potential for conflict between feeder buses and private vehicles was considered. Where there are more bus routes, there is increased potential for conflicts between personal vehicles and buses. However, multiple bus routes serving a station benefit train riders by providing multiple opportunities for local circulation and distribution without private vehicles. The number of bus routes would be high at the Mira Mesa (28 routes) and Downtown San Diego (33 routes) Stations; the Temecula, Escondido Rock Springs, and Qualcomm Stations would have a low number of bus routes—6 or fewer. The other 12 stations would have a medium (between 6 and 28) number of bus routes. However, the HST Alternative overall would not have transit impacts beyond those of the Modal and No Project Alternatives.

High-Speed Alignment Options Comparison

These are the major alignment and station options compared in this section.

- San Bernardino loop compared to San Bernardino downtown bypasses.
- Carroll Canyon option compared to Miramar Road option.
- Qualcomm terminus compared to downtown terminus.

The San Bernardino loop would provide service to a major intermodal transfer location at the Santa Fe Depot as well as better regional coverage for northern Riverside and San Bernardino Counties. This benefit would need to be evaluated, taking into account the 4-to 8-minute delay incurred by routing trains to a station in San Bernardino. The Carroll Canyon alignment in San Diego County would represent a new transportation corridor, in contrast to the Miramar Road alignment, which has heavy congestion and space limitations. In San Diego, the Qualcomm terminus would potentially provide easier access, parking, and station location opportunities than the downtown terminus, but would not serve the central business district core without requiring an additional transfer to light rail and necessitating additional travel time.

E. LOS ANGELES TO SAN DIEGO VIA ORANGE COUNTY

Modal Alternative

Intercity Highway Segments: The number of segments operating at LOS F would decrease from eight under the No Project Alternative to five under the Modal Alternative. As shown in Table 3.1-9, the average V/C ratio would improve by approximately 14%. The potentially most substantial improvement compared to the No Project Alternative would occur along I-105 at Inglewood Avenue, where the LOS would remain LOS F, but the V/C ratio would decrease by 21%, from 1.98 to 1.57.

Table 3.1-9
Segments Operating at LOS F (V/C Higher than 1.0)
Los Angeles to San Diego via Orange County (LOSSAN)

Alternative	Number of Segments at LOS F	V/C % Change
No Project[a]	8	19%
Modal[b]	5	-14.4%
HST[b]	6	-3.0%

[a] Compared to existing conditions.
[b] Compared to No Project Alternative.
Source: Parsons Brinckerhoff 2003.

Proposed High-Speed Train Stations: Compared to the No Project Alternative, the Modal Alternative would not change traffic conditions around the proposed HST stations, except at the LAX Terminal Station. Under the Modal Alternative, the V/C ratio at the LAX Terminal Station would increase by 6%, and the LOS would degrade from LOS E to LOS F compared to the No Project Alternative.

Airports: Planned capacity improvements would occur at John Wayne International-Orange County Airport and Long Beach Municipal Daugherty Field under the Modal Alternative. Near LAX, the aggregate LOS on roadway links to the terminal would worsen from LOS E to LOS F, and the V/C ratio would worsen from 0.97 to 1.03 compared to the No Project Alternative. Near LGB, the aggregate LOS on roadway links to the terminal would worsen from LOS A to LOS B, and the V/C ratio would worsen from 0.59 to 0.64 compared to the No Project Alternative. These airport roadway links are projected to worsen under the Modal Alternative because peak-period traffic accessing the airports would increase.

Transit, Goods Movement, and Parking: The Modal Alternative would have no significant impacts on transit compared to the No Project Alternative. Planned increases in bus and commuter rail service are expected to meet demand for transit. Also, the Modal Alternative is not expected to have any significant impact on goods movement compared to the No Project Alternative.

Except at the proposed Norwalk (which is a new station and does not have any parking associated with the location yet) and San Juan Capistrano (which is constrained by many historic properties surrounding the station site) Stations, parking capacity at each station is projected to meet the demand of travelers under the Modal Alternative; there would be no significant change compared to the No Project Alternative.

High-Speed Train Alternative

Intercity Highway Segments: Under the HST Alternative, traffic congestion is projected to improve slightly on the intercity highway segments compared to the No Project Alternative. The most significant changes would occur on I-5 at Balboa Avenue and on I-5 at Tamarack Avenue, where the LOS would improve from LOS F to LOS E and from LOS D to LOS C, respectively. The average regional V/C ratio would improve by 3%.

Proposed High-Speed Train Stations: The HST Alternative would cause no significant changes in LOS or V/C ratios within the station areas compared to the No Project Alternative.

Airports: The HST Alternative would cause no significant changes in LOS or V/C ratios in the LAX and Long Beach Municipal Daugherty Field areas compared to the No Project Alternative.

Transit, Goods Movement, and Parking: The HST Alternative would cause no significant impacts on public transportation or goods movement compared to the No Project Alternative.

Except at the proposed Norwalk Station, parking capacity at each station is projected to meet the demand of travelers under the HST Alternative; there would be no significant change compared to the No Project Alternative. Under the HST Alternative, potential parking impacts could occur at the Norwalk Station because available land around the HST station areas is lacking.

High-Speed Train Alignment Option Comparison

Only the LOSSAN segment has an alternative alignment that presents significant differences in transportation impacts. One alignment option involves using the existing LOSSAN passenger rail corridor; the other option involves using the Union Pacific Railroad's (UPRR's) Santa Ana subdivision right-of-way.

The existing LOSSAN corridor option would allow for the use of an existing right-of-way from Los Angeles to Irvine in Orange County. This option would have fewer impacts on existing freight rail services in Orange County because the service could continue operations on the corridor while the HST was being constructed. This option also would allow use of an existing higher-speed rail infrastructure, further minimizing the traffic and circulation impacts in the cities traversed by the alignment. Between Los Angeles and Fullerton, this corridor represents the Burlington Northern Santa Fe Railroad's (BNSF's) primary freight line out of the Los Angeles Metropolitan Area. This option would involve using four tracks: two dedicated to passenger service and two to freight.

The UPRR Santa Ana Branch Line option would also allow for a dedicated HST alignment that uses an existing railroad right-of-way for most of the distance between Los Angeles and Anaheim in Orange County. However, this option would present a high impact on the existing local freight service on the Santa Ana Branch Line, which is estimated to be between two and four hauler trains per day. Although this service does not represent heavy traffic, these trains typically operate at about 10 mph (16 kph) and spend long periods on the track. It is assumed that this service would have to be removed from the line because of the limited existing right-of-way. Potential benefits associated with the HST Alternative include the full grade separation of major arterial and highway crossings (see Appendix 3.1-B). There are 26 at-grade crossings between Los Angeles and Irvine. Of the 26 grade separations, seventeen would occur between Anaheim

and Los Angeles; of those, 11 would be on the LOSSAN corridor option and 6 would be on the UPRR Santa Ana Branch option.

3.1.5 Design Practices

The HST system would be fully grade separated from all roadways allowing vehicular traffic to flow without additional impediment in the local circulation system. In the urban areas where traffic congestion is typically at the highest levels, the HST system is predominantly in or adjacent to existing rail corridors/services and would include a considerable amount of grade separation of the existing tracks. These features included as part of the HST project implementation would improve No Project traffic levels of service and safety highway circulation system.

To minimize potential traffic and circulation impacts, HST stations in California will be multi-modal transportation hubs. All the potential high-speed rail station locations were selected at sites that would provide linkage with local and regional transit, airports, and highways. In particular, convenient links to other rail and transit services (heavy rail, commuter rail, light rail, conventional intercity rail, and local and regional bus services) would promote efficient circulation around stations by increasing availability and efficiency of transfers to these other transit and rail services.

Through the HST systems primary purpose of serving intercity travel and its capability to provide express or long distance commuter services, the implementation of the proposed system would result in a direct reduction of overall vehicular travel and roadway congestion, particularly in urban areas where congestion is the greatest.

3.1.6 Mitigation Strategies and CEQA Significance Conclusions

Currently, regional planning agencies and the counties and cities in the regions have considerable flexibility to deal with identified traffic, transit, and parking impacts. The California High Speed Rail Authority could participate in developing potential construction and operational mitigation measures in consultation with state, federal, regional, and local governments and affected transit agencies during project-level reviews.

Potential mitigation measures could be developed to improve the flow of intercity travel on the primary routes and access to the proposed stations or airports. These improvements would be based on the forecast capacity deficiencies identified for the No Project, Modal, and HST Alternatives and could possibly employ some of the following approaches.

- Transportation System Management (TSM)/Signal Optimization (including retiming, rephrasing, and signal optimization); other measures may include turn prohibitions, use of one-way streets, and traffic diversion to alternate routes.
- Local spot widening of curves that allows for geometric improvements without significant right-of-way acquisition.
- Major intersection improvements (full lane widening), which require significant right-of-way acquisition to accommodate additional left-turn and/or through lanes.

V/C ratios on the major intercity routes identified in the system screenline analysis show the desirability of more capacity on several freeway segments under all alternatives. When considering measures for traffic mitigation, the increase in automobile congestion and lowered vehicle flows that would be caused by the HST Alternative would be studied at the project-level analysis in the context of providing a new form of transportation (HST) and would consider total passenger flow versus vehicle flow in the study area if the HST alternative is selected. Further, the people-carrying capacity of the HST Alternative would be considerably higher than the capacity of the potentially feasible lane additions described in the Modal Alternative, allowing it to more easily absorb trip growth.

Consultation and coordination with public transit services in order to encourage the provision of adequate bus feeder routes to serve proposed station areas could mitigate potential transit impacts.

In each case where impacts are deemed significant at the project level, mitigation measures would be proposed. The potential for localized increases in automobile congestion and impaired vehicle flows caused by the HST Alternative would be offset by the new transportation service, to the point where the total flow of people in the corridor would increase at many locations. Further, the people-carrying capacity of the rail system is considerably higher than comparable lanes of roadway, enabling the HST alternative to more easily absorb growth in trip making. These effects should be considered when determining appropriate levels of traffic mitigation.

Potential mitigation strategies that might be associated with the HST Alternative are listed below by regional and local applications.

Regional strategies:

- Coordination with Regional Transportation (highway and transit) planning (e.g., Regional Transportation Plans, Congestion Management Plans, Freeway Deficiency Plans, etc.)
- Intelligent Transportation Systems Strategies (ITS)

Local strategies:

- Provide additional parking
- Off-site parking with shuttles
- Shared parking strategies
- Parking permit plans for neighborhoods
- Parking and curbside use restrictions
- Develop and implement a construction phasing and traffic management plan
- Roadway widening
- Installation of new traffic signals
- Improve capacity of local streets with upgrades in geometrics such as providing standard roadway lane widths, traffic controls, bicycle lanes, shoulders and sidewalks
- Modifications at intersections, such as signalization and/or capacity improvements (widening for additional left-turn and/or through lanes)
- Signal coordination and optimization (including retiming and rephrasing)
- Designation of one-way street patterns near some station locations
- Truck route designations
- Turn prohibitions
- Use of one-way streets and traffic diversion to alternate routes
- Increase bus feeder service and/or add routes to serve the proposed station areas
- Increase service from other connecting/complimentary modes of transportation (commuter rail, bus and rail transit)

- Minimize closure of any proximate freight or passenger rail line or highway facility during construction.

Based on the analysis above, and considering the CEQA Appendix G thresholds of significance for traffic, the HST system alternative would have a positive effect when viewed on a system-wide basis, particularly by reducing traffic on highways and around airports to the extent that intercity trips are diverted to the HST system (see Table 3.1-4) and by eliminating delays at existing at-grade crossings where the HST system would provide grade separation. Around station areas an increase in traffic and congestion is expected with the proposed HST. At this programmatic level of analysis it is not possible to know precisely the location, extent, and particular characteristics of such increased traffic and congestion. For now, at the programmatic level of analysis, because of this uncertainty, the impact is significant. Mitigation strategies, as well as design practices discussed in Section 3.1.5, will be applied to reduce this impact.

The above mitigation strategies are expected to substantially lessen or avoid impacts around station areas in most circumstances. Planning multi-modal stations, coordinating with transit services, providing accessible locations and street improvements, and encouraging transit-oriented development in station areas, all will help to ease traffic constraints in station areas. At the second-tier, it is expected that for various projects involving HST stations impacts will be mitigated to a less than significant level, but it is possible that for some stations impacts will not be mitigated to the less than significant level. Sufficient information is not available at this programmatic level to conclude with certainty that the above mitigation strategies will reduce impacts around stations to a less than significant level in all circumstances. This document therefore concludes that traffic impacts around station areas may be significant, even with the application of mitigation strategies. Additional environmental assessment will allow a more precise evaluation in the second-tier, project-level environmental analyses. The co-lead agencies will work closely with local government agencies at the project-level to implement mitigation strategies.

3.1.7 Subsequent Analysis

If the HST Alternative is selected, subsequent multimodal access and circulation studies could be conducted at proposed station areas along proposed alignments as plans for alignments, stations, and operations are refined. Additional environmental analysis would be required in conjunction with these studies to ascertain the exact locations of potential project-generated traffic impacts and potential parking demand impacts and the potential effects on existing bus and rail transit ridership. Station area circulation studies would be expected as part of project-level environmental documentation.

3.2 TRAVEL CONDITIONS

This section addresses the travel conditions related to different transportation modes in the study area. This section describes existing conditions and describes the potential of the No Project, Modal, and High-Speed Train (HST) Alternatives to affect travel conditions. Automobile and air transportation currently carry more than 98% of intercity trips, and are therefore the focus, together with the HST mode, of this section. For this analysis, *travel conditions* are defined as the experience, quality, sustainability, safety, reliability, and cost of intercity travel within the study area. Travel factors were developed based on the purpose and need (Chapter 1) for the proposed HST system and are used to evaluate the general impact of proposed changes to the transportation system for each of the alternatives.

3.2.1 Methods of Evaluation

A. METHOD OF EVALUATION OF IMPACTS

The overall method used to evaluate travel conditions is described below. To evaluate the relative differences in travel conditions that would result from implementation of the alternatives, six travel factors were considered that relate directly to the purpose and need and the goals and objectives defined in Chapter 1. These factors are listed below.

- Travel time.
- Reliability.
- Safety.
- Connectivity (both modal and geographic).
- Sustainable capacity.
- Passenger cost.

Travel Time

Travel time is the total time required to complete a journey. With the exception of the automobile, intercity transportation options require multiple modes to complete a trip. Most people acknowledge that an air trip is not just the time spent in the air (the line-haul portion of the trip), but also includes the time required to travel to the airport, check in, pass through security, board the plane, and travel to the final destination. The total travel time of a mode is also dependent on its reliability. If a mode is unreliable, a traveler must allow more time to complete a trip, effectively lengthening the total travel time.

Reliability

Reliability is the delivery of predictable and consistent travel times and is a key factor in attracting passengers to use a particular mode of travel. Travel time and reliability directly affect productivity, as they determine the ease and speed with which workers and products arrive at their destinations. Greater travel demand on capacity constrained facilities results in further congestion and is one of the primary reasons for longer travel times. Reliability is primarily a function of unexpected delays due to many factors, including traffic congestion, accidents, mechanical breakdowns, roadwork, and inclement weather.

Safety

Projected growth in the movement of people and goods in California by road and air underscores the need for improved travel safety. National and statewide statistics indicate that the rate of fatality or serious injury by private motor vehicle is increasing, primarily because more people are traveling by

this mode. Nationally, over the last 10 years, accident and injury rates have remained fairly constant for commercial airline travel, which remains a safe mode compared to the private automobile.

Connectivity (Modal and Geographic)

Modal: Connections between modes of transportation are an element in the development and operation of a successful total transportation system. The ability to transfer easily between modes and the frequency of service are additional key factors that can determine a traveler's modal choice. Statewide, connections between airports and the extensive regional urban and commuter transit systems are currently limited. Under existing conditions and No Project, modal connections at airports are limited, and the connections and services available are fragmented and not provided as an integrated system with coordinated fares, schedules, and amenities. With the exception of the new BART extension to San Francisco International Airport (SFO) and the Metrolink connection to Burbank Airport, other airports do not have direct rail connections to city centers, other transit systems, or the region. At these airports, transit connections can be cumbersome, often requiring multiple transfers and long waiting times, are not well advertised to potential passengers, and lack coordinated fares and schedules.

Geographic: Connecting the northern and southern urban areas of the state (southern California and San Francisco Bay Area) with an additional transportation system could significantly improve statewide mobility. Connecting these urban areas with the cities and communities of the Central Valley could yield potential benefits. Due to poor connectivity, limited services, and weather impacts, travel options to and from Central Valley cities are limited, travel times are long, and the potential for delay is high.

Sustainable Capacity

Sustainable capacity is a measure of the transportation system's capability to meet projected demand without the need to develop additional infrastructure. The current California transportation system is stressed beyond capacity in many places and for considerable periods of the day. Rush "hour" is a thing of the past. As demand increases without sufficient capacity, the severity of the congestion will increase and result in more frequent delays and longer peak travel periods throughout the day. This demand-capacity imbalance will worsen over time as system use increases. As a result, the transportation system will lose the ability to absorb short-term or long-term demand increases and become increasingly inflexible because of the lack of capacity. Indeed, travelers are already witnessing this phenomenon on many of California's major highways and at its major airports. US-101 between SFO and Redwood City is typically congested beyond traditional peak periods, and Los Angeles International Airport (LAX) regularly suffers significant flight delays due to congested conditions for arriving or departing flights.

Cost

Direct, passenger-borne costs are another key factor in passenger travel choice. Most travel demand studies have found that travel costs are highly variable, depending on the type of traveler and the purpose of travel. Business travelers may be willing to pay high fares for urgent needs, but leisure travelers may constrain themselves to the lowest fare possible. In some cases, travelers are also willing to pay a premium for a reliable, comfortable, and safe journey.

The six travel factors are summarized in Table 3.2-1. These travel factors are used to evaluate the relative difference between alternatives both qualitatively and quantitatively. The method by which the travel factors have been applied to the alternatives is summarized in Table 3.2-2. Each of the travel factors is described in greater detail as they are applied in the potential environmental consequences of travel conditions discussion.

In general, the No Project and Modal Alternatives would include the same intercity travel modes that are available under existing conditions, which are the automobile, airplane, intercity bus, and conventional rail. The intent of the environmental analysis performed in this Program EIR/EIS is to broadly assess the highest potential level of impact. Therefore, the high-end forecasts for the HST (68 million trips) are used to describe the operations and required facilities for the proposed alternatives. However, in a few areas where the high-end forecast produced the lowest impacts or highest benefit, analysis of conditions based on the low-end HST forecast (42 million trips) is also included. Both the high- and the low-end include 10 million long-distance commute trips.

Table 3.2-1
Relation of Travel Factors and Purpose and Need/Objectives

	Travel Factors					
	Connectivity	**Travel Time**	**Reliability**	**Safety**	**Sustainable Capacity**	**Passenger Cost**
Project Purpose						
To improve intercity travel experience	X	X	X	X	X	
To maximize intermodal transportation opportunities	X	X				
To meet future intercity travel demand	X	X				
To increase efficiency of intercity transportation system	X		X		X	
To maximize use of existing transportation corridors	X		X			
To develop a practical and feasible transportation system by 2020 and in phases	X					X
To provide a sustainable reduction in travel time		X			X	
Project Need						
Limited modal connections	X	X				
Future growth in travel demand					X	
Capacity constraints			X		X	
Unreliability of travel			X	X	X	
Project Goals and Objectives						
Maximize mobility	X				X	X
Minimize travel times		X				
Minimize environmental impacts					X	
Maximize system safety			X	X		
Maximize reliability			X			

X = Directly applies.
Source: Parsons Brinckerhoff 2003.

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

Table 3.2-2
Transportation Factors

Typology	Description	Measurement
Travel Time	Total door-to-door travel time	Total travel time including access and in-vehicle times
Reliability	Ability and perception to arrive at the destination on-time	Accidents Inclement weather Transportation-related construction Volume variation Special events Traffic control devices and procedures Base capacity Vehicle availability
Safety	Loss of life or injury	Comparison of safety performance characteristics by mode (operator, vehicle, and environment)
Connectivity	Transportation options that connect to other systems and destinations	Modal Number of intermodal connections and options, and frequency of service provided by each alternative Geographic Connectivity between regions by mode
Sustainable capacity	Ability to accommodate additional demand beyond the design demand	Amount of additional infrastructure required to meet a threshold demand above and beyond the design demand
Passenger cost	One-way travel costs	Total costs including fares and other costs for intercity travel by mode
Source: Parsons Brinckerhoff 2003.		

3.2.2 Affected Environment

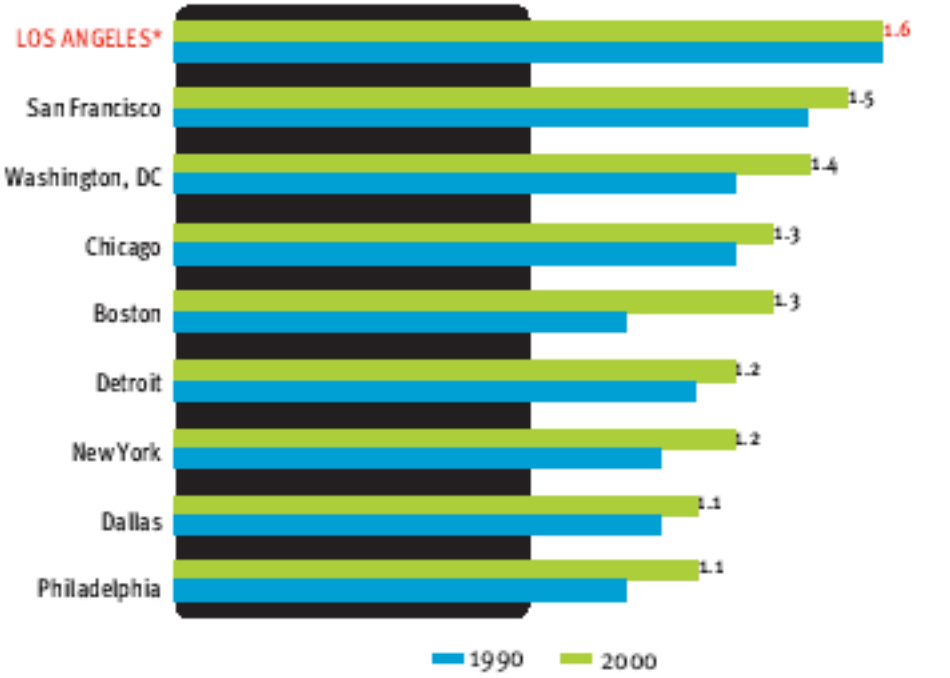
A. STUDY AREA DEFINED

This program-level analysis of travel conditions and potential impacts does not measure the specific potential impact on individual transportation facilities (e.g., a transit line, highway or airport). Rather, travel conditions have been evaluated for the total project area and regional level. Specific examples of representative travel conditions in a corridor or for a specific highway, airport, or rail facility are identified where possible. The study area for this analysis of travel conditions encompasses all five regions in the project area—Bay Area to Merced, Sacramento to Bakersfield, Bakersfield to Los Angeles, Los Angeles to San Diego via Inland Empire, and Los Angeles to San Diego via Orange County (LOSSAN).

B. GENERAL DISCUSSION OF TRAVEL CONDITIONS

For travel conditions, the affected environment is California's intercity travel network, which consists of three main components: highways, airports, and rail. Of these, automobiles and air transportation currently carry over 98% of intercity trips, and are therefore the focus of this section. Congestion in the affected environment is a serious concern, as shown in Figure 3.2-1. According to the Texas Transportation Institute, the urban areas of San Francisco and Los Angeles experience some of the most severe highway congestion and travel delays in the country (Shrank and Lomax 2002). Recent research by the Institute of Transportation Studies at the University of California,

Figure 3.2-1
Nationwide Highway Congestion



Includes Los Angeles and Orange Counties only
Source: Texas Transportation Institute

Berkeley, indicates that California airports generally experience the highest average air travel delays in the nation (Hansen et al. 2002). Although the main contributors to this congestion are local and commuter highway trips and transcontinental and international flights (at least at major airports such as SFO and LAX), intercity trips compete for the limited capacity on these overburdened facilities.

The highway system is congested near and around urban centers (e.g., San Francisco, Los Angeles, San Diego) and in rural and suburban communities (e.g., Central Valley) during both the morning and evening peak hours. The Los Angeles area has some of the worst travel delay—the extra time spent traveling because of congestion—in the country, according the Texas Transportation Institute (Shrank and Lomax 2002). According to San Francisco's Metropolitan Transportation Commission (MTC), seven out of ten of the most congested highway corridors in the Bay Area (including segments of I-880, I-580, and US-101) are key intercity routes in the Bay Area to Merced region (see Figure 3.2-2). Similarly, according to the San Joaquin Council of Governments, several major routes that traverse the Central Valley (I-5, I-205, I-580, SR-120, SR-99) are critical intercity links for passengers and goods traveling between northern and southern California. Section 3.1, *Traffic and Circulation,* of this Program EIR/EIS notes that several of these routes are currently operating during the peak periods at or near congested levels of operations. In fact, I-5 and SR-90 (key intercity routes assessed in this analysis) are designated by the California Department of Transportation (Caltrans) as "high emphasis focus routes" of critical importance to the movement of goods in California.

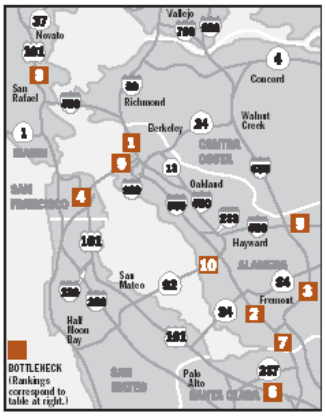
California's aviation system provides for intercity, domestic, and international travel. The aviation system is also a significant economic generator that fuels the state's economy. According to the Federal Highway Administration, in 2002 California's airports contributed to about 9% of the state's employment and total economic output (Federal Highway Administration 2003). According to Caltrans, in 2002 about 159 million passengers in California traveled by air, or about 12% of the national total. Seven California airports are ranked in the top 50 U.S. primary/commercial service airports. As shown in Table 3.2-3, all seven airports are located in one of the five regions considered in this analysis.

Table 3.2-3
California Airport National Rankings (2002)

Airport	U.S. Ranking	Region
Los Angeles (LAX)	3	Bakersfield to Los Angeles and Los Angeles to San Diego (via Inland Empire and Orange County)
San Francisco (SFO)	8	Bay Area to Merced
San Diego (SAN)	30	Los Angeles to San Diego (via Inland Empire and Orange County)
San Jose (SJC)	34	Bay Area to Merced
Oakland (OAK)	37	Bay Area to Merced
Sacramento (SMF)	44	Sacramento to Bakersfield
John Wayne/Orange County (SNA)	45	Los Angeles to San Diego via Orange County
Source: Aviation in California Fact Sheet, California Department of Transportation, Division of Aeronautics, 2002.		

The National Center of Excellence for Aviation Operations and Research predicted that demand at California airports, which dropped by as much as 33% after the September 11, 2001, terrorist attacks, will recover to 2000 levels in 2002 or 2003 or shortly thereafter (National Center of Aviation Operations and Research 2002). As a result, the seven major airports in Table 3.2-3 currently operating at or near capacity are all planning major improvements to accommodate existing and

Figure 3.2-2
Bay Area Locations of Worst Congestion (as of 2001)



10 Worst Congestion Locations in 2001*

2001 Rank	Location	Delay in Vehicle Hours	2000 Rank
1	**Interstate 80, westbound, a.m.** — Alameda/Contra Costa County Route 4 to Bay Bridge metering lights	9,410	1
2	**Interstate 880, southbound, a.m.** — Alameda County South of Route 84 to north of Dixon Landing Road	8,880	3
3	**Interstate 680, southbound, a.m.** — Alameda County Sunol Road to south of Route 262	8,510	2
4	**Interstate 80, eastbound and U.S. 101, northbound, p.m.** — San Francisco County Army Street to west end of Bay Bridge	5,050	5
5	**Interstate 580, eastbound, p.m.** — Alameda County Hopyard Road to west of El Charro	5,030	13
6	**U.S. 101, southbound, p.m.** — Santa Clara County Great America Parkway to 13th Street	4,100	4
7	**Interstate 880, northbound, p.m.** — Santa Clara/Alameda County U.S. 101 to Dixon Landing Road	4,000	12
8	**U.S. 101, southbound, a.m.** — Marin County Rowland Boulevard to Interstate 580	3,230	6
9	**Interstate 880, northbound, a.m.** — Alameda County 1 mile north of 7th Street to Bay Bridge	2,920	10
10	**Route 84, westbound, a.m.** — Alameda County Newark to Dumbarton Bridge toll plaza	2,860	11

Source: Caltrans District 4

*Rankings are for routes in which continuous stop-and-go conditions occur with few, if any, breaks in the queue. Thus, corridors that have equally severe delays but where congestion is broken into several segments may rank lower in this

future projected demand. In 2000, almost 25% of all flight arrivals were delayed for 9 minutes or more, a number significantly higher than the national average (Hansen et al. 2002).

Congested airways are one source of passenger delay for intercity trips; congested highways are another. According to the California Transportation Commission, California's major airports suffer from poor ground access and severe congestion, which directly impacts international trade (California Transportation Commission 2000). As shown in Section 3.1, *Traffic and Circulation,* many of the highway segments and primary airport access routes to the study area airports have a level of service (LOS) of E and F. *Level of service* describes the condition of traffic flow, ranging from excellent conditions at LOS A to overloaded conditions at LOS F. LOS D is typically recognized as an acceptable service level in urban areas.

3.2.3 Environmental Consequences

A. EXISTING CONDITIONS VS. NO PROJECT ALTERNATIVE

The No Project Alternative includes programmed and funded transportation improvements to the existing transportation system that will be implemented and operational by 2020. The primary differences between existing conditions and the No Project Alternative are the increased level of intercity travel demand and the implementation of new infrastructure. Improvements (programmed and funded) focus on existing modes; therefore, the same modes of intercity transport will continue to be available. The programmed or funded transportation improvements assumed to be in operation by 2020 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 or stabilization of existing highway or air travel conditions across the study area. Connectivity is not expected to improve with the No Project Alternative because few major intermodal terminals are expected to be built over the next 20 years.

As described in Section 3.1, *Traffic and Circulation*, existing facilities are currently operating at congested levels of service at many locations, and traffic conditions are projected to deteriorate further under the No Project Alternative. Of the 68 intercity highway segments analyzed in Section 3.1, more than half are operating during the peak period at LOS F or a volume-to-capacity (V/C) ratio more than 1.0 under existing conditions. These conditions are expected to deteriorate further under the No Project Alternative. On average, across all five regions, V/C ratios could deteriorate by almost 40%, and each region could have more LOS F segments under the No Project Alternative. Capacity in the No Project Alternative is insufficient to accommodate the projected growth in highway travel in every region, including both the traditional urban areas (e.g., the San Francisco Bay Area and Los Angeles basin) and the emerging urban areas in the Central Valley. Consequently, there would be no sustainable improvement to the transportation system's capacity.

Although intercity travel is only a small percentage of all highway trips, it must compete for limited capacity on already congested infrastructure for which insufficient capacity improvement projects are planned to be operational by 2020. For instance, according to MTC, between years 2000 and 2020 in the Bay Area, total vehicles per household will increase by 5%, and average vehicle miles traveled per weekday will increase by about 30%. This projection is representative of conditions throughout the state (Metropolitan Transportation Commission 2003). In the Central Valley, the San Joaquin Council of Governments estimates that the percentage of time vehicles are delayed relative to the total travel time will increase in 2025, and that the percentage of miles traveled at congested levels of service (LOS E or F) will increase from 1.25% in 1999 to more than 6% in 2025—a more than six-fold increase (San Joaquin Council of Governments 2002). In most cases, the potential impact of these conditions could manifest itself in deteriorating levels of service on highway segments and local streets or an extended peak-period congestion on links that are already operating at near or total breakdown conditions. In many instances, the morning peak period could extend from 2 hours to

4 hours. Likewise, as shown in Figure 3.2-3, increasing demand will lead to greater congestion, total travel time delay, and reduced reliability on the primary highway corridors in southern California.

According to the California Aviation System Plan, almost 173 million passengers enplaned and deplaned in California in 1999, a number that is expected to more than double by 2020 (California Department of Transportation 2001). Under the No Project Alternative, no additional runways or other major capacity expansion projects would be implemented by 2020. According to the Southern California Association of Governments, urbanized airports in southern California are already at 73% of total capacity and available capacity is rapidly diminishing (Southern California Association of Governments 2001). A similar trend can be expected across the state. As a result, many of the airports in the study area that are currently at or near capacity could become severely congested under the No Project Alternative. Capacity constraints are likely to result in significant future aircraft delays, particularly at California's three largest airports. SFO has "one of the worst flight delay records of major U.S. airports—only 64% of SFO flights were on time during 1998" (San Francisco International Airport 2003). According to SFO, within 10 years the three Bay Area airports will not have the sufficient capacity to meet regional air traffic demand even on a good weather day. LAX projects a demand of 19.2 million more annual passengers than their 78.7 million total passenger capacity by 2015, while San Diego International Airport expects to be at capacity prior to 2020 (San Diego Airport 2001). The projected delays at heavily used airports and forecasted highway congestion would continue to delay travel, negatively affecting the California economy and quality of life.

Given these travel trends, overall travel safety is also expected to worsen. As VMT continues to rise over the next 20 years under the No Project Alternative, the accident rate will not change appreciably, but the net number of accidents, injuries, and fatalities could increase, particularly for highway-based trips. As evidence of this trend, the National Highway Traffic Safety Administration reported that between 1998 and 2001 fatalities on California's roadways have increased by an average 4% annually (National Highway Traffic Safety Administration 2001).

Travel costs are also expected to rise because of capacity constraints. Regions could be faced with attempting to control demand through congestion pricing for both the auto and air modes. This approach could result in more congestion-priced toll roads like SR-91 in Orange and Riverside Counties, and peak-period landing fees for airports statewide. Both of these costs would be passed along to the consumer either directly in tolls or indirectly in ticketed fares.

As summarized in Table 3.2-4, the No Project Alternative could result in either a deteriorated LOS or no change compared to existing conditions.

Figure 3.2-3
Los Angeles Area Highway Congestion (2025 forecast)

Table 3.2-4
Existing Conditions Compared to No Project Alternative

	No Project Alternative (2020)	
Travel Factor	**Change from Existing Conditions**	**Comment**
Travel Time	Deteriorate	Increased congestion could result in further delays.
Reliability	Deteriorate	Increased congestion and no change in modal options or characteristics could result in greater unreliability.
Safety	Deteriorate	No change in modal options would maintain existing fatality and injury rates; however, increased demand could result in greater number of fatalities.
Connectivity	None	No additional intercity intermodal connections or options, or increased frequencies will be available.
Sustainable Capacity	Deteriorate	No significant mainline capacity improvements will be operational.
Passenger Cost	Deteriorate	Airfares are anticipated to increase beyond their current fare structures relative to other modal options.*

* Based on high-end forecasts from final business plan, California High Speed Rail Authority 2000.
Source: Parsons Brinckerhoff 2003.

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

This section presents expected travel conditions for the Modal and HST Alternatives and compares relative differences between No Project and the Modal and HST Alternatives. This section is organized by the six travel factors identified earlier. Only the HST Alternative would introduce a new mode to the California intercity transportation system. This new mode would result in some major differences in expected travel conditions. Each travel factor begins with a summary of the specific methods used to define and evaluate the Modal and HST Alternatives and the characteristics of each mode followed by an evaluation of impacts for the Modal and HST Alternatives.

Travel Time

Travel time is a key travel factor that determines the attractiveness of a particular mode of travel to passengers. Travel time is also an important economic factor that directly affects productivity (travel time for workers and products to get to their destination). For the purpose of this analysis, improved travel time is a benefit to the traveler because it can improve the intercity travel experience. Travel time for this analysis was measured as the total (door-to-door) travel time for the example city pairs presented in Chapter 1. Travel times representing the duration of the air or HST trips spent in the airplane or train (line-haul times) are included in Appendix 3.2-A.

Automobile Mode Characteristics: Travel time in an automobile largely depends on three factors: distance traveled, roadway design speed (and associated speed limit), and congestion levels. The design of a roadway dictates the time that will be required to travel between two destinations. The time of day and associated congestion also plays a role in how long a trip will take. For this analysis, it is assumed that the top speed of the automobile is 70 miles per hour (mph) (113 kilometers per hour [kph]).

Automobile travel times are based on driving times between the representative city pair origins and destinations, as summarized in Table 3.2-5. The travel time for existing conditions is the same as the times used in the California High Speed Rail Authority's (Authority's) final business plan (Business Plan) and is based on weighted averages of peak and off-peak travel times

(California High Speed Rail Authority 2000). To replicate the unique congested conditions in the San Francisco and Los Angeles areas, a delay penalty of 30 minutes (min) for trips originating in or destined for the San Francisco or Los Angeles regions was added to all year 2020 projections. This assumption was also incorporated in the higher-end HST ridership and revenue forecasts from the Business Plan. The travel time savings analysis developed for the economic growth analysis of this document (Chapter 5) shows that auto travel time for the Modal Alternative is estimated to be 8.5% shorter than for the No Project Alternative because of the reduction in congestion due to the increase in capacity on the highway system. In the same analysis, the auto travel times for the HST Alternative are estimated to be 4.1% shorter than the Modal Alternative because of the diversion of highway trips to the HST system (California High Speed Rail Authority 2000a).

Table 3.2-5
Total Door-to-Door Automobile Travel Times (Hours:Minutes)

City Pairs	Existing Conditions (1999)[a]	2020 (Alternatives) Automobile Total Door-to-Door Travel Times[b]		
		No Project	Modal	HST
Los Angeles downtown to San Francisco downtown	6:57	7:57	7:16	7:36
Fresno downtown to Los Angeles downtown	4:00	4:30	4:06	4:18
Los Angeles downtown to San Diego downtown	2:19	2:49	2:35	2:41
Burbank (airport) to San Jose downtown	5:50	6:50	6:15	6:32
Sacramento downtown to San Jose downtown	2:10	2:40	2:26	2:33

[a] California High Speed Rail Authority's final business plan, 2000, and Independent Ridership and Charles River Associates, Passenger Revenue Projections for High Speed Rail Alternatives in California, 2000.

[b] Sum of existing conditions plus representative delay penalty of 30 min for origin and destinations at San Francisco or Los Angeles, which is consistent with the high-end revenue and ridership forecasts for the Business Plan. Under the low-end revenue and ridership analysis the travel time under No Project would be the same as existing conditions.

Source: Parsons Brinckerhoff 2003.

Air Mode Characteristics: Air travel is the fastest line-haul mode at 530 mph (853 kph) maximum cruising speed. However, a significant portion of a passenger's trip is spent accessing the airport, passing through one or more security checkpoints, boarding and alighting the aircraft, and egressing the airport. The components of a door-to-door air trip include the components listed below. (See Appendix 3.2-B for more detailed explanation.)

- Access time: time spent driving to the airport.
- Terminal time: time spent getting through the airport terminal.
- Line-haul time: time spent on the aircraft.
- Arrival time: time spent getting to the final destination.

It is assumed that all air trips would require travel on the regional highway system with the exception of San Francisco, where some passengers could use the newly opened BART to SFO rail link. Also, passengers in the Los Angeles area could use a Metrolink connection to Burbank.

Total air travel times are summarized in Table 3.2-6. As shown, No Project travel times would increase between 15 and 30 minutes compared to existing conditions, depending on city pairs.[1] These changes are due to increases in line-haul travel time resulting from insufficient capacity at airports under No Project. It is estimated that air travel times would change under the Modal and HST Alternatives compared to No Project because the additional infrastructure under the Modal Alternative and the diversion of trips to HST would reduce airside congestion levels, while all other factors (arrival, terminal, and departure times) would remain constant (California High Speed Rail Authority 2003). Although there would be an improvement of intercity highway travel times, this improvement is not meaningful for access trips to and from the airports.

Table 3.2-6
Total Door-to-Door Air Travel Time (Hours:Minutes)

City Pairs	Airports	Existing Conditions (1999)	2020 Alternatives Air Mode Total Door-to-Door Travel Times		
			No Project Alternative[a]	Modal[b]	HST[c]
Los Angeles downtown to San Francisco downtown	LAX, LGB, BUR, SNA, ONT, SFO, OAK, SJC	3:02	3:32	3:27	3:26
Fresno downtown to Los Angeles downtown	FAT, SNA, ONT, LAX, LGB, BUR	2:47	3:02	3:01	3:00
Los Angeles downtown to San Diego downtown	LAX, LGB, BUR, SNA, ONT, SAN	2:30	3:00	2:45	2:46
Burbank (Airport) to San Jose downtown	BUR and SJC	2:44	3:14	3:09	3:08
Sacramento downtown to San Jose downtown	SMF and SJC	No Service	No Service	No Service	No Service

N/A = Not applicable.

[a] 15-min penalty for San Francisco, Los Angeles, and San Diego area airports based on high-end ridership and revenue forecasts from the Business Plan. Under the low-end forecasts, travel time in 2020 would be the same as under existing conditions.

[b] Total travel time reduced based on increase in capacity at airports.

[c] Total travel time reduced because of reduction in demand at airports from trips shifting from air to HST.

Source: Parsons Brinckerhoff 2003.

High-Speed Train Mode Characteristics: With a maximum operating speed of 220 mph (354 kph), the HST is slower in line-haul speed than an airplane but considerably faster than an automobile. However, for most intercity trips within California, the quick arrival, terminal, and departure times make the overall HST travel time competitive with that of air travel. The HST would also connect closer city pairs, those less than 150 mi (241 km) apart, and for those trips would compete strongly with the automobile. For example, HST travel between Los Angeles and Bakersfield or Sacramento and Modesto would likely be faster than automobile travel.

In Europe and the United States, rail travel time improvements have shifted travel demand from air to rail travel. Within a decade of its inauguration, France's Train à Grande Vitesse (TGV) Sud-Est succeeded in capturing more than 90% of the travel market between Paris and Lyon (Meunier 2002). Amtrak's Acela and Metroliner trains have 50% of the total air-rail market, which is split between New York and Washington. In Germany, recent passenger rail improvements between Frankfurt and Cologne were undertaken with the purpose of shifting air

[1] This assumption is consistent with the high-end revenue and ridership assumptions for the Business Plan.

trips from congested airports where capacity was constrained and could not be expanded to high-speed rail that could more quickly serve the same markets. This same principle could apply to the major airports in the study area, including San Francisco and Los Angeles. The air operation time-slots released by substituting HST for local air service at these two airports could provide more opportunities for international and interstate flights.

HST would also provide direct connections to several airports. This connectivity, combined with the line-haul speed of the HST, could result in faster total travel times for air travelers who use air travel and the HST to reach their final destination. For example, passengers arriving at San Francisco could transfer to the HST and travel to Merced, and this connection could be competitive with or possibly faster than connecting to another flight, driving, or taking a bus or shuttle.

The train in this instance may be quicker for two reasons. First, trains may be boarded swiftly, often in less than 2 minutes because of the number of doors and ability to accommodate extra passengers. In contrast, boarding an airplane must be controlled for security and typically takes place through one door (or at most two doors), a process that can take up to half an hour. Second, current airline boarding practice requires passengers to be present at the gate at least 20 minutes before the scheduled departure time.

Another key difference between HST and air travel is the percentage of total travel time spent during the line haul. On a train, this proportion of time is quite high, and can be used for work, pleasure, or relaxation. For example, passengers traveling by HST between any of the below city pairs would be able to use their laptop computers or any number of personal audio, video, or game devices for approximately 70% of the total travel time, while passengers traveling by air would be able to use these devices for just 30% of their trip.[2]

Total travel times are summarized in Table 3.2-7. Since no HST exists or would exist under the No Project or Modal Alternatives, only the travel times for the HST Alternative are shown. While these travel times are from downtown to downtown where HST has a distinct advantage over air travel because of terminal locations, the potential for many online stations could make the HST competitive for many other trips. Like air travel, the HST has the following door-to-door trip components. (See Appendix 3.2-B for more detailed explanation.)

- Access time: time spent driving to the train station.
- Terminal time: time spent getting through the train station.
- Line-haul time: time spent on the train.
- Arrival time: time spent getting to the final destination.

[2] Although the line-haul time of the flight is about 33% of the total trip, due to restrictions on use of electronics during take off and landing, the productive time is reduced by another 10%.

Table 3.2-7
Total Door-to-Door High-Speed Train Mode Travel Times (Hours:Minutes)

City Pairs	2020 HST Total Door-to-Door Travel Times
Los Angeles downtown to San Francisco downtown	3:20[3]
Fresno downtown to Los Angeles downtown	2:23
Los Angeles downtown to San Diego downtown	2:16
Burbank (airport) to San Jose downtown	2:52
Sacramento downtown to San Jose downtown	1:53
Source: California High Speed Rail Authority 2000.	

Existing conventional rail services are typically not competitive with other modes. For example, while the HST line-haul time (a component of total trip time) between downtown San Francisco and Los Angeles would be just under 2.5 hrs, the only existing direct rail service between the Bay Area (Oakland) and Los Angeles (Coast Starlight service) currently has a line-haul time of more than 12 hrs and operates one train daily in each direction. The San Joaquin service between Oakland and Los Angeles currently takes about 8 hrs and 40 min but requires transferring to a bus for the Bakersfield to Los Angeles segment of the trip. The HST line-haul time between downtown Los Angeles and downtown San Diego would be about 1 hr and 13 min as compared with current Surfliner line-haul time of 2 hrs and 45 min. Caltrans and Amtrak plan to reduce travel times by up to 30% on key intercity routes such as the Pacific Surfliner and Capitol Corridor services over the next 20 years; however the projects required to reach these goals are not yet funded.

Alternatives Comparison for Travel Time

No Project Alternative: There are no travel-time benefits associated with the No Project Alternative because there are no significant improvements to capacity or modal options. The No Project Alternative would likely result in longer travel times in all cases as compared to existing conditions, and these increases would range between 15 and 60 minutes for the representative city pairs.

Modal Alternative: The Modal Alternative could achieve up to a 16-min reduction in travel time for the representative city pairs compared to the No Project Alternative. The greatest savings would be achieved in the most congested corridors of Sacramento to San Francisco. These benefits would occur primarily due the additional highway capacity in the Bay Area and southern California regions with the Modal Alternative. It is estimated that with the additional capacity proposed for airports there would be some travel time benefits over the No Project Alternative.

High-Speed Train Alternative: The greatest time savings would be achieved using express service between Fresno and Los Angeles and between Los Angeles and San Diego. Because of its faster line-haul speed, HST would compete with the automobile for shorter distance intercity trips. Because of its shorter terminal processing times, HST would also compete with the airplane for longer distance intercity trips. In the Central Valley, HST would provide shorter travel times than both the highway and air modes for travelers headed to locations near HST stations.

[3] Time based on I-5 alignment option. Antelope Valley alignment option would be 3:30, an additional 10 minutes.

Reliability

In its simplest form, *reliability* can be defined as variation in travel time, hour-to-hour and day-to-day for the same trip. Reliability is important for almost any travel need and on any travel mode. Business travelers want to be able to predict how long it will take them to arrive at a meeting, either across town or across the state. Express shippers need to know where packages are at all times and when they will be available for delivery. Vacationers who want to spend as little of their time off as possible traveling to and from their destinations often find themselves making their trips during the most congested days of the year. Reliable travel means fewer late arrivals, improved efficiency, saved time, and reduced frustration.

Travel on most transportation modes is consistent and repetitive, yet at the same time highly variable and unpredictable. This apparent contradiction accrues because travel is consistent and repetitive since peak usage periods occur regularly and can be predicted. The relative size and timing of rush hour is well known in most communities. Simultaneously, travel is variable and unpredictable because on any given day unusual circumstances such as a rainstorm or an auto accident can cause serious delays at any time.

The traveling public's experience with variations in travel reliability affects their decisions of how and when to travel, so that they have a reasonable expectation that they will arrive at their destination at a particular time. For example, if a highway is known to have highly variable traffic conditions, a traveler using that route to catch a flight routinely leaves extra time reach the airport.

Travel time reliability is the direct result of the variable and often unpredictable events that can occur on different travel modes and at any time of day. The traditional way of measuring and reporting travel times experienced by highway users is to consider only average or typical conditions. However, the travel times experienced by users are seldom constant, even for travel on the same facility in the same peak or off-peak time period. Reliability is influenced by several underlying factors that vary over time and that influence the environment within which transportation operates. These factors are listed below.

Incidents: *Incidents* are events that disrupt normal travel flow, such as obstructions in the travel lanes of highways. Events such as vehicular crashes, mechanical breakdowns, and debris in travel lanes are the most common form of incidents for any mode. On highways, events that occur on the shoulder or roadside can also influence traffic flow by distracting drivers, leading to changes in driver behavior and ultimately to the quality of traffic flow.

Inclement Weather: *Inclement weather* and related environmental conditions (rain, fog, snow, ice, sun glare, etc.) can lead to changes in operator behavior, vehicle performance, and operational control requirements that affect traffic flow. Motorists respond to inclement weather by reducing their speeds and increasing their headways. Airport and civil aviation authorities respond by grounding flights or delaying takeoffs and landings. In cases of severe weather, authorities respond by closing roadways and creating vehicle caravans.

Construction: Construction can often reduce the number, width, or availability of travel lanes, rail tracks, and runways. Nearby construction activities can also reduce reliability if operating rules or conditions are changed (e.g., slow orders on rail tracks). Delays caused by work zones have been cited by highway travelers as one of the most frustrating conditions they encounter on trips.

Volume Variation: *Volume variation* is day-to-day variability in demand that leads to some days with higher travel volumes than others. Different demand volumes superimposed on a system with fixed capacity results in variable, less reliable travel times.

Special Events: Special events such as concerts, fairs, and sports events cause localized congestion and disruption in the vicinity of the event that is radically different from typical travel patterns in the area.

Traffic Control Devices and Procedures: These can lead to intermittent disruption of travel flow through means such as air traffic control, railroad signals and switches, railroad grade crossings, drawbridges, and poorly timed signals.

Base Capacity: *Base capacity* refers to the physical capacity of a transportation system, such as the number the highway lanes or runways. The interaction of base capacity with the other influences on reliability has an effect on transportation system performance. This is due to the nonlinear relationship between volume and capacity on any mode. When congested conditions are approached, small changes in volume lead to diminished throughput of the transportation system and consequent large changes in delay. Further, facilities with greater base capacity are less vulnerable to disruptions; for example, an incident that blocks a single lane has a greater impact on a highway with two travel lanes than a highway with three travel lanes.

Vehicle Availability and Routing: These can directly affect a traveler's ability to make an on-time trip, particularly on a common carrier such as airplane and train, or by rental car. End-to-end routing, hubbing,[4] and other strategies to maximize vehicle operation time can affect reliability when a vehicle that is needed in one location first has to complete a trip from a different location. Short layovers or "pads" that are scheduled between trips for a given vehicle also affect vehicle availability.

The extent to which these eight factors affect each of the major intercity travel modes, and by extension the Modal Alternative and HST Alternative, is analyzed and compared on a qualitative basis by describing and ranking the extent to which each travel mode is potentially susceptible to each of the eight factors. It is presented in Table 3.2-8 and further detailed below. Because the alternatives are composed of combinations of modal elements (including different modes for trip segments like station or terminal access), modal rankings have been combined, providing a qualitative understanding of the reliability of each alternative.

Table 3.2-8
Modal Reliability

	Relative Susceptibility to Reliability Factors*		
Factor	**Air**	**Automobile**	**High-Speed Train**
Incidents	**Low** Air travel has very few major incidents, and is generally not influenced by incidents on other modes.	**High** Automobile travel can be influenced by minor and major incidents at any location along the roadway and is frequently affected by incidents outside of the right-of-way.	**Low** HST has very few major incidents and is generally not influenced by incidents on other modes since the number of grade crossings is minimal or non-existent.
Weather	**High** A variety of weather conditions anywhere in the country can affect air travel.	**High** A variety of weather conditions can degrade operator ability, make roadways impassible, or damage roadways.	**Low** Trains can operate under virtually any conditions. Guideway is constructed to minimize weather impact.

[4] Hubbing is a reference to the "hub and spoke" operations practice where airlines coordinate a large number of their flights to arrive at a major terminal at the same time to allow passengers to transfer from one plane to the next to complete their trip to their final destination.

Factor	Relative Susceptibility to Reliability Factors*		
	Air	Automobile	High-Speed Train
Construction	**Low** Most activities scheduled for periods of low airport usage. High-quality construction minimizes routine maintenance needs.	**Moderate** Construction activities (major and minor) are common, but generally occur during warm weather months. Lane closures are often of long-term duration.	**Low** Most activities are scheduled for hours when system is closed. High-quality construction minimizes routine maintenance needs.
Special events	**Low** Special events (e.g., air space closure) are generally rare but can lead to rerouting or airport closure when they do occur.	**Moderate** Special events are common and can create volume fluctuations or short-term lane closures.	**Low** Most special events can be easily accommodated on HST without effect on travel time. Guideway closures are uncommon for this factor.
Traffic control devices or procedures	**Moderate** Reliability strongly influenced by air traffic control rules and capabilities.	**Moderate** Auto travel influenced by traffic signals, railroad crossings, and other devices. Influence depends on level to which devices are optimized.	**Low** HST operates in exclusive, grade-separated right-of-way, minimizing external influences. Double-tracked guideway minimizes switching needs. HST control systems are redundant and highly automated, allowing for a high level of precision in dispatching and control.
Inadequate base capacity	**Moderate** Capacity can be strong influence due to complex procedures for gate usage, taxiing, and takeoffs/ landings. This factor has strong interaction with weather at certain airports.	**High** This is one of the strongest influences on highway reliability, particularly for facilities with three or fewer lanes per direction. Travel time degrades quickly as capacity is approached.	**Low** HST system generally has large capacity reserve. Operations are not allowed to exceed design capacity. Exclusive guideway maintains high level of base capacity at all times.
Volume variation	**Moderate–High** Air travel demand and number of scheduled flights fluctuates broadly from day to day. Aircraft loading and unloading times directly affected by passenger volumes.	**High** Peak-period travel in medium to large urban areas highly influenced by day-to-day or seasonal volume variations. Strong interaction with inadequate base capacity.	**Low** Day-to-day variation in train volumes tends to be low. Passenger volume variation generally does not influence travel times.
Vehicle availability or routing	**High** Airplanes are used multiple times in a given day, and availability can be affected by factors anywhere in the world and with any type of routing system (point-to-point or hub-and-spoke). High capital cost discourages airlines from keeping large reserve fleet.	**Low** Private automobiles are ubiquitous and are widely available for rental in emergency situations. The road and highway network provides alternative routes for most trips.	**Moderate** HST vehicles complete multiple end-to-end trips in a day, potentially affecting availability at specific times and locations; simple routing schemes generally followed.

* High indicates that the factor can exert a strong negative influence on travel time reliability for the mode. Conversely, low indicates that the factor generally does not play a role in influencing travel time reliability for the mode.

Source: Cambridge Systematics, Inc. 2003.

Automobile Mode Characteristics: On a day-by-day basis, automobiles tend to be the least reliable of the three modes. Highway travel is highly or moderately susceptible to seven of the eight factors described above. It is only when considering the influence of vehicle availability and routing that automobiles potentially would have a lower susceptibility than other modes.

Recent research provides further evidence on the unreliability of highway travel (Texas Transportation Institute and Cambridge Systematics, Inc. 2003). This research, which used actual travel time data covering 579 mi (932 km) of freeways in the Los Angeles area, shows that reliability problems exist on highways at all times of the day, all days of the week, and all weeks of the year. This research expressed unreliability in terms of a *buffer index,* the amount of extra time motorists would need to budget to be certain of arriving on time at their destination 95% of the time. Results showed that a motorist in Los Angeles would need to allow an additional 45 min for a typical 1-hr highway trip—fully 75% of normal driving time. Even in midday periods, a traveler would need to budget an additional 30 min for the same 1-hr trip, or 50% of the normal time. It is important to note that a buffer does not represent certainty, and on any given day this buffer may or may not be needed.

Air Mode Characteristics: Despite its high average speed, air travel often suffers from reliability problems due to a number of factors. The data in Table 3.2-8 suggest that air travel is moderately or highly susceptible to weather, vehicle availability, volume variation, inadequate base capacity, and traffic control procedures. Air travel is more susceptible than the other two modes to reliability problems arising from weather and vehicle availability. Bad weather and a shortage of aircraft in other states can impact service in California. Air travel reliability is generally not, however, influenced by incidents, construction, and special events.

Airline on-time statistics compiled by the Federal Aviation Administration show air travel reliability problems are widespread in California. Airline on-time statistics are available through the Bureau of Transportation Statistics Web site (http://www.bts.gov/ntda/oai). These statistics were reviewed to compare actual versus scheduled flight times for flights departing from Sacramento (SMF), SFO, LAX, and San Diego (SAN) in June 2002.[5] The statistics were analyzed to determine the median scheduled flight time and the 95th percentile actual flight time for flights departing from these four airports.[6] These times and the resulting buffer are shown in Table 3.2-9.[7]

The data in Table 3.2-9 indicate that air travel is generally more reliable than highway travel, as suggested by the smaller buffers (10 to 15% for air travel versus 50 to 75% for highway travel). Nonetheless, the data also show that air travelers at these four airports still need to budget an additional 9 to 18 min of in-vehicle travel time to account for unforeseen reliability problems that often arise with air travel.

[5] Statistics were analyzed for all flights operated by Alaska, America West, American, American Eagle, Delta, Southwest, United, and United Express. These eight airlines account for more than 95% of domestic departures at these four airports. More than 29,000 individual flights were included in the sample.

[6] The 95th percentile was chosen to maintain consistency with the research results reported for the highway mode.

[7] As with the highway mode, the buffer indicates the additional time needed above the average (median) time air travelers would need to budget to arrive on time for their flight with 95% certainty. For air travel, the buffer is expressed as a percentage of the median flight time.

Table 3.2-9
Reliability Statistics for Air Travel in California

Airport	Delay (95th Percentile Travel Time)	Scheduled Flight Time (Median)	Buffer (Delay/Scheduled Flight Time)
Sacramento (SMF)	9 min.	85 min.	10.6%
San Diego (SAN)	12 min.	90 min.	13.3%
San Francisco (SFO)	18 min.	118 min.	15.3%
Los Angeles (LAX)	12 min.	110 min.	10.9%
Source: Bureau of Transportation Statistics, June 2002.			

High-Speed Train Mode Characteristics: HST has been shown to have a low susceptibility to nearly all of the major factors that affect reliability. It is only on the issue of vehicle availability that HST, like all common carrier modes, has a higher level of susceptibility than highways. Also, HST has the same or lower level of susceptibility on all eight factors compared with air travel or even conventional rail.

Statistics from HST operations in Europe and Asia further confirm the high level of reliability that is inherent with HST. In France, more than 98% of TGV train runs have been completed within 1 min of schedule. In Spain during 2002, 99.8% of AVE runs were completed within 5 min of schedule. In Japan, the JR Central Shinkansen line averaged a 16-second delay per train in 2002. Using the buffer concept that was described for highways and air, these data suggest that HST travelers would likely need to have a schedule buffer less than 1 min (less than 1% of scheduled travel time) to account for unforeseen delay and reliability. This in-vehicle travel time buffer is extremely small compared to all other modes.

HST systems have proven worldwide to be far more reliable than conventional U.S. intercity rail services. Several factors account for this reliability.

- Intercity rail service involves mixed operations between conventional intercity passenger services and heavy freight traffic, whereas the HST service would not share tracks with heavy freight services.
- Depending on location and number of operations, the quality of train signal/control/dispatch systems for freight rail systems vary, whereas the HST services would use state-of-the-art automated control systems.
- Most conventional intercity passenger rail routes operate on freight railroads that are dispatched by the host freight railroad. Therefore, dispatching decisions may be based first on the needs of the host railroad, and then on the needs of the passenger train. For example, if a freight train is too long to go into a siding, the dispatcher will have to put the passenger train in the siding to wait until the longer freight train passes. This is just one type of delay for passenger trains using freight railroads.
- Grade crossings are inherently dangerous, providing the opportunity for vehicle and pedestrian collisions and delay due to malfunction of grade-crossing protection equipment. The HST service would be completely double-tracked, fenced, and grade-separated.

Although detailed statistics were not available, reports on rail operations in California suggest that conventional rail reliability is low (California Department of Transportation 2002). While Amtrak strives to complete a minimum of 90% of its train runs on time, the most recent data shows that the Capitol Corridor is on time about 84% of the time, while intercity service within

the LOSSAN corridor is on time about 78% of the time. Monthly statistics for the Capitol Corridor show that the 90% on-time goal has only been reached in 2 of the past 24 months.

Alternatives Comparison for Reliability

A qualitative comparison of the alternatives was conducted by considering the relative reliability of the modes that are present in each alternative, the relative modal usage in each alternative, and any major changes such as highway lane additions or modal diversion that are present in an alternative. As described more fully below, the HST Alternative is projected to have the highest reliability, while the No Project Alternative is projected to have the lowest reliability.

No Project Alternative: Reliability under the No Project Alternative is likely to be lower than under the other alternatives for the following reasons.

- The No Project Alternative depends heavily on the automobile, which has been shown to have the worst reliability of the three modes.
- Existing congestion and reliability problems continue, because the No Project Alternative provides no new highway and airport base capacity.
- Greater highway and aviation congestion and more reliability problems accrue, because the No Project Alternative absorbs an increasing demand for travel with little increase in base capacity.

Modal Alternative: The Modal Alternative is likely to have better reliability than the No Project Alternative, but poorer reliability than the HST Alternative for the following reasons.

- The Modal Alternative depends heavily on the automobile, which has been shown to have the worst reliability of the three modes.
- Lower congestion and less susceptibility to reliability problems would result because the Modal Alternative could provide more base capacity to carry the expected increase in travel demand on highways and at airports than the No Project Alternative.

The Modal Alternative is likely to result in lower highway and air congestion levels than the HST Alternative since there is a measurable increase in capacity for both modes. Since the capacity increases between the No Project Alternative and the Modal Alternative but the number of intercity trips does not, less delay is accredited under the Modal Alternative to capacity constraints on both roadways and at airports. Nonetheless, Chapter 1 and Section 3.1 of this Program EIR/EIS have shown that the Modal Alternative would still experience near-capacity conditions on many highways and airports, increasing the likelihood of reliability problems. These problems would be compounded by the lack of a reliable alternative travel mode, such as the HST.

High-Speed Train Alternative: The HST Alternative is likely to provide the greatest degree of travel reliability for the following reasons.

- HST would divert significant levels of intercity demand from less reliable modes, particularly highways.
- HST provides a completely separate transportation system that would have less susceptibility to many factors influencing reliability.
- Highway and air travel reliability would improve because HST reduces travel demand on highways and air.

The various HST alignment options are not likely to exhibit appreciable differences in system reliability since system capacity and demand would be roughly equivalent. Major design differences (e.g., extent of tunneling) would not make a meaningful difference in reliability, and differences in base travel times on HST would not influence reliability.

Sensitivity to Travel Demand Forecasts: As with travel time, reliability is also influenced by the level of travel demand. Other things being equal, reliability is expected to be better on facilities that have lower travel demand (or experience lower V/C ratios) due to the non-linear relationship between volume and capacity, as mentioned above. Therefore, lower levels of highway or air travel demand, such as those suggested by the base Business Plan forecasts, would be expected to improve reliability for the highway and air modes for the Modal and HST Alternatives. The reliability improvement would likely be greatest for the No Project Alternative since its base capacity is most constrained and would experience the largest relative improvement in V/C ratios and delay. For the same reasons, the Modal Alternative would likely experience the second-largest reliability improvement, and the HST Alternative would experience the smallest improvement. Nonetheless, given the large reliability advantage enjoyed by the HST mode, the HST Alternative would still be expected to provide the greatest degree of travel reliability across the range of travel demand scenarios suggested in the Business Plan.

Safety

In transportation, three basic characteristics interact to influence the safety of a mode.

- Operator: His or her training, regulation, and experience.
- Vehicle: Its condition, regulation, control systems, and crashworthiness.
- Environment: Weather, guideway type, guideway condition, and terrain.

Each of these characteristics plays a role in the overall safety of the modes, which for this analysis is quantified as the probability of passenger fatality. Injuries are more difficult to compare between modes because they are categorized differently by mode and different injury ratings are used. For instance, automobile injuries are generally related to automobile crashes, while for air, bus, and rail they can include injuries that occur as part of a crash, while boarding/alighting, or in the terminal. The severity of these injuries can vary from scrapes and bruises to life-threatening ones. For the purposes of this analysis, injuries by mode will be discussed but are not measured as a key indicator of safety. This analysis also only considers injuries and fatalities of passengers and does not include employees or other staff.

To compare the relative impact of safety between alternatives, fatalities are measured by rate of fatality per 100 million passenger miles traveled. For this analysis the high-end forecasts were assumed because this approach will present the worst case for potential fatalities for all modes and alternatives. The safest mode is the one that has the lowest number of fatalities per 100 million passenger miles traveled (PMT).

Automobile Mode Characteristics: The automobile is unquestionably the most used and the most dangerous mode of transportation being considered in this Program EIR/EIS. The National Highway Traffic Safety Administration estimates that the national motor vehicle fatality rate is 0.80 fatalities per 100 million passenger miles traveled. Nationally in 2000, there were about 6.4 million reported motor vehicle crashes that resulted in 42,000 fatalities and 3.2 million injuries. About 4.2 million crashes involved property damage only (National Highway Traffic Safety Administration 2001). The National Highway Traffic Safety Administration estimates that deaths and injuries resulting from motor vehicle crashes are the leading cause of death for persons between the ages of 4 and 33, while traffic-related fatalities account for more than 90% of all transportation-related fatalities. According to the California Highway Patrol, in 2000 there

were 3,331 fatal crashes in California alone (California Highway Patrol 2000). The risk to an individual depends most strongly on the time spent behind the wheel or in the passenger's seat. The longer the journey or the more frequently the journey is made, the greater the risk of a crash. Some of the factors that influence auto and highway safety are listed below.

- Operator.
  - Drivers vary in age, experience, ability, and many other factors.
  - Non-professional drivers typically operate automobiles.
  - Limited regulatory requirements govern who can operate an automobile and the type of training that is needed, and these requirements vary between states.
- Vehicle.
  - Privately owned vehicles are mechanically not as reliable as the public transportation modes.
  - Maintenance and inspections are not regulated, and are performed by mechanics of varying skill levels.
  - Crashworthiness and roadworthiness varies depending on make and model.
  - Minimum requirements rather than optimum standards dictate safe operating conditions.
- Environment.
  - Highways provide no latitudinal or longitudinal control to individual automobiles.
  - Fixed objects (e.g., trees, light poles, sign posts) are frequently placed within the highway right-of-way.
  - Weather and lighting conditions (wind, rain, fog, snow, ice, darkness, and sun glare) can adversely impact vehicle and driver performance.
  - Traffic control systems that regulate the speed and safe operation of an automobile are limited in influence.
  - Roadway conditions and designs are varied and can include systems based on different design speeds, vehicles, and operating conditions.
  - Drivers are subject to a multitude of potential distractions and interferences.

Air Mode Characteristics: Air travel is a safe mode of travel and in recent years has become even safer with the introduction of improved aircraft and state-of-the-art air traffic control systems. According to the U.S. Department of Transportation, the likelihood of fatality due to commercial air travel is relatively small (0.02 fatalities per 100 million PMT). According to the University Of Michigan Transportation Research Institute, flying a typical nonstop flight is 65 times safer than driving the same distance. Takeoff and landing presents the greatest safety risk during a flight; between 1991 and 2000, 95% of all airline fatalities occurred either during takeoff or landing, and just 5% of fatalities occurred at cruising altitudes (Sivak and Flannagan 2002). Consequently, the risks of flying depend mostly on the number of segments flown and not on the distance flown. Injuries associated with air travel can occur during the process of boarding and alighting, and during flight. Most are relatively minor and include scrapes, bruises, broken bones, and a few serious falls. Some of the factors that influence air travel safety are listed below.

- Operator.
  - Commercial aircraft can only be operated by professional pilots, who are rigorously trained and must update their proficiency regularly.
  - Other airline personnel such as flight attendants are trained to provide immediate assistance in emergency situations.
  - Pilots are subject to drug tests and are regulated by the Federal Aviation Administration.
  - Automation of fight operations is well developed and commonly installed.
- Vehicle.
  - Aircraft are regularly maintained to high standards and the Federal Aviation Administration regularly inspects these maintenance records.
  - Aircraft themselves are constructed of high-grade metals and, provided they are maintained regularly, can be in active service for decades.
  - All aircraft occupants are required to wear seatbelts during takeoffs and landings, the two procedures that present the greatest safety risk.
  - Air traffic control systems in the United States are standardized and are some of the safest, most reliable systems in the world for controlling commercial aircraft and warning them of potential dangers.
- Environment.
  - One of air travel's greatest weaknesses is its vulnerability to weather. Although most commercial aircraft can fly above or below most storm systems, they often have no choice during takeoffs and landings but to fly through thunderstorms, snow, ice, and fog. Particularly severe weather conditions can ground all aircraft and prevent those in flight from landing.
  - Unexpected turbulence during flight can injure passengers. For this reason, passengers are often required to wear seat restraints and are discouraged from walking or standing during flight.
  - Aircraft have no guideway to provide latitudinal or longitudinal control, and therefore run the risk of striking fixed or other flying objects while on the ground or during flight.

High-Speed Train Mode Characteristics: Based on statistics from Europe and Japan, HST is the safest mode of travel.[8] Since 1988, there have been 85 injuries and 14 fatalities[9] reported on all dedicated HST systems in Europe. In Japan's 34 years of HST operations, no passenger fatalities have been reported. For the purposes of this analysis and for comparison purposes only, it is assumed that the fatality rate for HST is less than air travel but greater than 0.0, or 0.001 per 100 million PMT. Similar to air travel, the likelihood of injury is associated with boarding and alighting, and during operation, with injuries ranging from minor to severe. The distinguishing reasons for the safety of HST travel relative to air and highway travel are summarized below. The HST mode would be much safer than conventional intercity rail services in California, which operate on freight railroads that have a mix of rail traffic and grade crossings.

[8] There are no statistics for HST safety in the United States.

[9] The worst accident on a dedicated high-speed right-of-way was a derailment in Piacenza, Italy in 1997, which resulted in eight fatalities.

- Operator.
  - HST operators would be rigorously trained and tested and are required to update their qualifications regularly.
  - HST operators would be required to submit to drug tests and are subject to regulation by the FRA and operating railroads.
  - The train would be completely automated and the train operator would be a failsafe redundant system component that could act in the unlikely case that a system malfunction or other problem occurs.
- Vehicle.
  - The FRA passenger equipment safety standards (49 C.F.R. Part 238) dictate the buff strength or amount of force a train can withstand in a collision, for all passenger equipment. The buff strength is adjusted to the operating and rail traffic conditions and is designed to minimize injuries of fatalities due to rail crashes.
  - The trains would be completely automated, allowing for centralized command and control of the train system, effectively eliminating the chance of operator error. Much like the BART system in the San Francisco Bay Area, a centralized system would control the operation of the train while the operator would be the physical eyes and ears of the train ensuring passenger safety.
  - Like airplanes, trains and the infrastructure they operate on (tracks, control systems, and electrification systems) would be maintained on a regular schedule. Maintenance records are subject to inspection by the FRA.
  - Like aircraft, passenger train equipment is built for a long service life. If maintained properly, a modern train car can have a useful life of at least 30 years.
  - HST traffic control and communications systems are state-of-the-art, regulated and managed during all hours of operation. These systems control the train's speed, schedule, routing, and headway (following distance behind another train). These systems combined with the operator have integral redundancy and ensure safety.
- Environment.
  - The HST system would be fully access controlled and grade-separated (including grade crossings), virtually eliminating pedestrian and motor vehicle conflicts.
  - The HST system would be closed to all other rail traffic, greatly reducing the possibility of collision with other trains. An exception is the Caltrain corridor between Gilroy and San Francisco, where the HST would travel at reduced speeds and share the track with express commuter passenger trains.
  - Inclement weather has only a minimal impact on HST operations. Because it is nearly impossible to read line side signals flashing by at 200 mph (322 kph), HSTs use a cab signaling system that transmits commands directly to the driver. This technology makes high-speed operation possible in darkness, rain, and fog. In Japan, even moderate snowfall does not slow the Shinkansen because of special ice-melting equipment built into the rail bed.
  - Unlike aircraft, HST systems are not subject to turbulence. Passengers may sit without seat restraints and may stand and walk comfortably even at maximum speeds and around curves.
  - Although HST systems do operate in highly seismic areas such as Japan, no fatalities have ever occurred as a result of a seismic event. Failsafe technology would stop the

trains when an earthquake is detected, and at-grade construction in fault zones would further improve safety.

- The HST system, like other public intercity modes, is inspected on a regular schedule as required in federal regulations. This regular inspection of both rolling stock and track would ensure the safety of the HST.

The safety characteristics of each mode are summarized in Table 3.2-10. This table shows that for all three safety characteristics, the HST mode has the best safety performance. While air and HST are similar in regard to operator and vehicle characteristics, HST performs better with regard to the environment because the HST is capable of operating safely and comfortably in a variety of climatic conditions compared to aircraft, without the need for passenger restraints. The automobile mode fares poorest in terms of safety.

Table 3.2-10
Safety Performance by Mode

	Safety Performance Characteristics		
Mode	**Operator** **Training** **Regulation** **Experience**	**Vehicle** **Condition** **Regulation** **Control systems** **Crashworthiness**	**Environment** **Weather** **Guideway condition** **Terrain**
Automobile	Poor	Good	Poor
Air	Excellent	Excellent	Poor
HST	Excellent	Excellent	Excellent

Alternatives Comparison for Safety

The safety performance for each alternative is shown in Table 3.2-11. The HST Alternative has the best overall safety performance primarily because it diverts 34 million annual passengers from the least safe automobile mode to HST[10], the safest mode. This demand shift combined with the rigorous requirements of HST operators, regular vehicle inspection, maintenance, control systems, crashworthiness, and ability to operate in virtually all weather conditions, make the HST Alternative superior to No Project and Modal Alternatives.

Table 3.2-11
Safety Performance by Alternatives

	Safety Performance Characteristics		
Alternative	**Operator** **Training** **Regulation** **Experience**	**Vehicle** **Condition** **Regulation** **Control systems** **Crashworthiness**	**Environment** **Weather** **Guideway condition** **Terrain**
No Project	Good	Good	Poor
Modal	Good	Good	Poor
HST	Excellent	Excellent	Excellent

[10] This number is based on the high-end ridership forecast for the HST based on the Business Plan. If the HST ridership were less (42 million instead of 68 million, including 10 million long-distance commuters for both the low and high forecasts), then fewer trips would be diverted from auto, effectively increasing the overall number of potential fatalities per year.

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

No Project Alternative: While the rate of injury or fatality is not expected to increase under the No Project Alternative, the increase in highway travel would be expected to cause the number of injuries and fatalities to increase as compared to existing conditions.

Modal Alternative: No significant safety benefits are associated with the Modal Alternative compared to the No Project Alternative, with about the same number of highway-related fatalities projected to occur under either scenario. However, because the Modal Alternative would provide some excess capacity not used by intercity highway or air trips, the additional capacity would likely be absorbed by commuting or other local trips. These induced trips could add to the amount of travel (PMT) on certain segments and could increase the number of fatalities. Furthermore, while the Modal Alternative also includes an improvement to air travel capacity and may ultimately increase the demand for air travel, these trips are more likely to use local and regional roadway systems to access the airports than under the HST Alternative, and this outcome could also pose a potential safety risk.

High-Speed Train Alternative: The HST Alternative would produce the greatest safety benefit compared to the No Project and Modal Alternatives. HST would divert about 34 million annual intercity highway trips from the Modal or No Project Alternatives, resulting in fewer injuries and fatalities annually.

Connectivity

Connectivity in the study area can be measured qualitatively and quantitatively using the number of modal options that offer competitive transportation services, the availability of intermodal connections, and the frequency of service (number of departures). A greater number of competitive modal options is considered a benefit because it increases the diversity, redundancy, and flexibility of the overall transportation system and provides travelers with greater choices.

- *Modal options* are a measure of the intercity modal diversity of each of the alternatives.
- An *intermodal connection* or facility allows passengers to transfer from one mode to another to complete a trip. A connection can be as simple as a timed connection between a train and a bus or as elaborate as the BART connection to SFO where air, rail, and bus all converge to give multiple transportation options.
- *Frequency* is measured as the number of departures available to travelers in the study area. High service frequency benefits travelers because it increases the number of possible connections to different modes and the number of options available for travel to a destination.

Modal Options: The No Project Alternative provides four modal options: automobile, air, intercity rail, and intercity bus. However, intercity travel in California is dominated by automobile and air transportation. The automobile accounts for over 88% of all intercity trips, with air transportation representing more than 10% and conventional rail carrying most of the remaining trips. Although the automobile and air modes compete against one another for the longer-distance intercity trips, such as San Francisco to Los Angeles, the automobile is without rival for many intermediate intercity trips. Table 3.2-12 shows intercity trips by mode between the major metropolitan regions in the study area. Between the San Francisco Bay Area and the Los Angeles Metropolitan Area, air transportation serves almost 52.5% of the travel market, with the automobile accounts for 47.3%, and conventional rail 0.2%. Only air transportation offers fast enough travel times to compete for the long-distance business travel market. Trips between the Central Valley and either the San Francisco Bay Area or the Los Angeles Metropolitan Area are good examples of intermediate intercity trips. For these markets, the automobile serves 97.3% of the travel market, while air transportation has 1.5% and conventional rail about 1.2%.

Table 3.2-12
1997 Intercity Trip Table Summary[a]

Market	1997 Base Trip Tables		
	Air	Auto	Amtrak Rail
Los Angeles to Sacramento	2,179,140	2,861,527	9,129
Los Angeles to San Diego	407,185	34,870,032	934,322
Los Angeles to San Francisco	9,376,455	8,442,469	36,525
Sacramento to San Francisco	40,797	20,475,524	502,956
Sacramento to San Diego	613,341	736,732	[b]
San Diego to San Francisco	2,417,203	2,387,001	[b]
Los Angeles/San Francisco to Valley Cities	368,805	23,747,021	290,896
Other	250,059	43,157,606	225,434
Total	15,652,986	136,677,910	2,000,351

[a] Air trips in this table are "local" (or true origin/destination) air trips between metropolitan areas. Connect air trips (which are not destined to a city within the corridor), and their potential for diversion to HST were forecast in the previous study using a separate procedure and subcontractor. The diversion to HST of connect trips is small in absolute numbers, and limited to a few shorter distance intercity markets. The previous connect air forecasts of HST ridership are used in this study as appropriate for the applicable Modal or HST Alternative.

[b] Amtrak trips for these markets are essentially zero and are therefore excluded from the table for clarity.

Source: U.S. Department of Transportation, Caltrans, and Charles River Associates, January 2000.

The Modal Alternative would provide additional capacity but no additional modal options beyond those existing or in the No Project Alternative.

The HST Alternative would provide a new intercity, interregional, and regional passenger mode that would improve connectivity to other existing transit modes and airports. HST would bring competitive travel times and frequent and reliable service to the traditional urban centers of the San Francisco Bay Area, Los Angeles Metropolitan Area, Sacramento, and San Diego. It would significantly improve the modal options available in the Central Valley and other areas of the state currently not well served by public transport (bus, rail, air) for intercity trips.

Tables 3.2-13 (low end) and 3.2-14 (high end) show intercity trips by mode between the major metropolitan regions in the study area projected for 2020 with a statewide HST system. Under the low-end or Business Plan assumptions, between the San Francisco Bay Area and the Los Angeles Metropolitan Area, HST is projected to capture at least 43% of the travel market. Air transportation would serve up to 24% of the travel market, the automobile up to 33%, and conventional rail virtually none of the market. For the high-end ridership assumptions, between the San Francisco Bay Area and the Los Angeles Metropolitan Area, HST is projected to capture up to 71% of the travel market, with the automobile as low as 28%, air transportation serving as little as 1%, and conventional rail virtually none of the market. For trips between the Central Valley and either the San Francisco Bay Area or the Los Angeles Metropolitan Area, the automobile would serve nearly 79% of the intercity travel market, while HST would capture nearly all the remaining 21% for the low-end forecasts (nearly 76% automobile trips and 24% HST trips for the high-end forecasts). The HST Alternative would provide similar benefits to other intermediate intercity markets served by the HST system. For longer-distance intercity trips, HST would provide a competitive alternative to driving and flying. For intermediate intercity trips, HST would also be an attractive alternative to driving.

Table 3.2-13
2020 Intercity Trip Table Summary Business Plan Scenario (Low End)

Market	2020 Business Plan Trip Tables			
	Air	Auto	Amtrak Rail	HST[a]
Los Angeles to Sacramento	1,132,827	2,720,332	97	3,384,964
Los Angeles to San Diego	20,805	42,023,218	298,843	5,304,220
Los Angeles to San Francisco	6,487,057	8,549,065	162	11,269,050
Sacramento to San Francisco	2,696	26,448,373	351,485	1,690,169
Sacramento to San Diego	745,079	644,200	61	702,630
San Diego to San Francisco	2,820,117	2,191,051	75	2,228,436
Los Angeles/San Francisco to Valley Cities	32,624	54,950,291	50,583	5,153,090
Other	5,286,399[b]	30,179,854	73,545	2,269,543
Total	16,527,605	167,706,384	774,851	32,002,103

[a] Low-end Business Plan ridership forecast.
[b] Other trips—connecting air trips from outside of the state.

Table 3.2-14
2020 Intercity Trip Table Summary Sensitivity Analysis Scenario (High End)[a]

Market	2020 Business Plan Trip Tables			
	Air	Auto	Amtrak Rail	HST[b]
Los Angeles to Sacramento	29,070	3,176,209	97	6,141,554
Los Angeles to San Diego	1,393	50,373,405	298,843	7,444,541
Los Angeles to San Francisco	287,089	9,503,243	162	24,338,901
Sacramento to San Francisco	2,546	30,853,989	351,485	2,246,588
Sacramento to San Diego	60,065	707,496	61	1,749,001
San Diego to San Francisco	177,361	2,315,668	75	6,609,892
Los Angeles/San Francisco to Valley Cities	7,636	64,680,617	50,583	7,228,074
Other	5,277,019[c]	34,315,568	73,545	2,638,702
Total	5,842,178	195,926,194	774,851	58,397,253

[a] Air trips in Tables 3.2 13 and 3.2 14 are "local" (or true origin/destination) air trips between metropolitan areas. Connect air trips (which are not destined to a city within the corridor), and their potential for diversion to HST were forecast in the previous study using a separate procedure and subcontractor. The diversion to HST of connect trips is small in absolute numbers, and limited to a few shorter-distance intercity markets. The previous connect air forecasts of HST ridership are used in this study as appropriate for the applicable Modal or HST Alternative.
[b] High-end Business Plan ridership forecast.
[c] Connecting air trips from outside of the state.
Source: Charles River Associates, January 2000.

Intermodal Connections: The automobile can be used to go virtually anywhere in California. Unlike common carrier transportation modes (air, bus, or rail), the automobile does not require or depend upon intermodal connections to get from the trip origin to the trip destination. The automobile mode would have the same flexibility in the Modal Alternative and the HST Alternative.

Scheduled airline service allows a traveler to reach any destination served by commercial airlines in a relatively short travel time. Unlike the automobile, commercial air travel requires intermodal connections to get to the airport and to a final destination. Moreover, airports are predominately located outside major city centers, a considerable distance from the major transit hubs, which are typically downtown. With the exception of the San Francisco and Burbank airports, which are served directly by rail, all airports in California require transfers to automobiles or road-based public transportation.

It is assumed that there would be limited new intermodal connections under the No Project and Modal Alternatives because a limited number of these improvements are currently planned and programmed.

HST stations would be generally located at existing transportation centers that can serve a wider area through public transit and would enhance intermodal connections in each region. HST stations in the traditional urban cores of the Sacramento, San Francisco Bay, and Los Angeles areas would connect to the heart of the established public transit networks. For example, Los Angeles Union Station (LAUS) is projected to be the most heavily used HST station. LAUS is the transit hub of Los Angeles County and is the primary destination for the Metrolink Commuter rail services, the Los Angeles Metro Red Line, the Pasadena Gold Line, the Amtrak Surfliner service, and the regional bus transit services. The potential station at the Transbay Terminal in San Francisco would be located in the heart of San Francisco's financial district and within walking distance of all major downtown hotels, the convention center, and Union Square retail. The Transbay Terminal would also serve Caltrain commuter rail, all the major bus services to downtown San Francisco, BART, and the extensive San Francisco Municipal Railway (Muni) light-rail system.

HST could have a profound effect on the Central Valley and on outlying areas that are not currently well served by other forms of public transportation. HST would provide convenient and reliable connections to the airports and downtowns of San Francisco and Los Angeles, and to Central Valley cities. All of the potential HST station sites in the Central Valley would either be in city centers or at transportation hubs (airports and Amtrak stations).

Frequency: The automobile, by offering unlimited potential frequency and because it can be driven at virtually any time and to virtually any destination, has the highest connectivity of any mode.

Although 17 commercial airports are included in this study, the range of city pairs served is considerably narrower because little to no commercial service exists between some of the city pairs. Air travel is market-driven and consequently airlines concentrate their operations on markets that are profitable. The San Francisco Bay Area to Los Angeles Metropolitan Area corridor is the most heavily traveled air corridor in the world. This intercity travel market and the long distance markets to/from Sacramento and to/from San Diego have many daily departures and arrivals. In other regions such as the Central Valley, where demand is lower and the distances shorter, the number of daily flights serving California intercity markets is far more limited. Table 3.2-15 shows the daily 1997 average air frequencies by airport pair (Charles River Associates, Inc. 2000). While LAX had service to eight airports within the study area with over ten flights daily in each direction, Fresno had only two (Los Angeles and San Francisco) and Bakersfield only one (Los Angles). Merced, Modesto, Stockton, and Visalia had virtually no air service within the study area.

The additional air transportation capacity provided by the Modal Alternative would likely result in frequency increases between the airports where improvements were made. In particular, based on the assumptions for the Modal Alternative, air service between Fresno and the major

metropolitan areas (Sacramento, the San Francisco Bay Area, Los Angeles, and San Diego) could be significantly improved.

The HST system adds a new intercity service to the statewide intercity transportation network that would offer a variety of services with different stopping patterns (express, skip-stop, and local services) to serve long-distance, intermediate, and shorter-distance intercity trips. Consequently, HST would increase frequencies for some city pairs that are not well served by air transportation. In addition to the major city pairs, smaller cities in the Central Valley and suburban cities surrounding the major markets would be directly connected with frequent intercity service.

Table 3.2-15
Daily 1997 Average Air Frequencies by Airport Pair (Each Direction)[a,b]

	BFL	BUR	CLD	FAT	LAX	MCE	MOD	MRY	OAK	ONT	SAN	SCK	SFO	SJC	SMF	SNA
Bakersfield																
Burbank	0															
Carlsbad	0	0														
Fresno	0	4	0													
Los Angeles	19	0	13	30												
Merced	0	0	0	1	0											
Modesto	0	0	0	0	0	0										
Monterey	0	0	0	0	20	0	0									
Oakland	0	15	0	0	35	0	0	0								
Ontario	0	0	0	4	15	0	0	0	12							
San Diego	0	6	0	3	76	0	0	0	11	0						
Stockton	0	0	0	0	0	0	0	0	0	0	0					
San Francisco	5	13	0	17	49	2	5	15	0	8	25	0				
San Jose	0	8	0	0	27	0	0	0	1	7	14	0	0			
Sacramento	3	10	0	2	13	0	0	0	0	10	11	0	20	0		
Orange County	0	0	0	4	17	0	0	3	13	0	1	0	10	14	5	
Visalia	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0

[a] Three-digit codes for airports used as the column headings correspond to the airport names in the row headings.

[b] Data for this table has changed considerably since 1997. For example, there are currently 18 non-stop flights between Los Angeles and Fresno, and seven between San Francisco and Fresno.

Source: Official Airline Guide online database, with calculations by Charles River Associates.

The proposed HST system would serve about 20 to 30 stations (depending on alignment option selected). Table 3.2-16 shows the number of daily trains (for each direction) served for each station pair as assumed for the Business Plan. This table shows that, compared to air transportation, the addition of HST service would greatly increase the number of trains serving major and intermediate destinations. For example, Fresno is expected to have service to 20 stations/cities with frequencies of at least 10 trains daily in each direction, while Bakersfield would have service to 19 stations/cities with frequencies of at least 10 trains daily in each direction. Central Valley cities such as Merced, Modesto, Stockton, and Visalia as well as additional urban markets in the San Francisco Bay Area and southern California such as East San Gabriel Valley, Palo Alto/Redwood City, Riverside, Sylmar, and Escondido, would all receive frequent service to all HST stations.

Table 3.2-16
2020 High-Speed Train Frequencies by Station Pair (Each Direction)

	S.D.	M.M	ESC	TEM	RIV	ONT	E.S.G.	L.A.	BUR	SYL	BAK	TUL	FSN	L.B.	GIL	S.J.	R.C.	SFO	S.F.	MER	MOD	STK	SAC
San Diego																							
Mira Mesa	39																						
Escondido	39	39																					
Temecula	39	39	39																				
Riverside	39	39	39	39																			
Ontario	39	39	39	39	39																		
East San Gabriel	39	39	39	39	39	39																	
Los Angeles	52	39	39	39	39	39	39																
Burbank	31	31	31	31	31	31	31	34															
Sylmar	31	31	31	31	31	31	31	34	34														
Bakersfield	30	22	22	22	22	22	22	33	21	21													
Tulare Co	11	11	11	11	11	11	11	11	12	12	12												
Fresno	25	17	17	17	17	17	17	28	14	14	28	12											
Los Banos	7	8	8	8	8	8	8	8	8	8	8	8	10										
Gilroy	20	20	20	20	20	20	20	23	23	23	12	8	11	10									
San Jose	28	22	22	22	22	22	22	33	23	23	20	8	19	10	25								
Redwood City/Palo Alto	20	20	20	20	20	20	20	23	23	23	12	8	11	10	25	25							
SFO	20	20	20	20	20	20	20	23	23	23	12	8	11	10	25	25	25						
San Francisco	36	26	26	26	26	26	26	46	23	23	21	8	19	10	25	35	25	25					
Merced	4	4	4	4	4	4	4	4	4	4	4	4	4	4	9	9	9	9	9				
Modesto	8	5	5	5	5	5	5	8	4	4	8	4	8	9	9	9	9	9	9	13			
Stockton	13	10	10	10	10	10	10	13	9	9	10	4	11	9	9	9	9	9	9	13	17		
Sacramento	16	13	13	13	13	13	13	9	9	10	11	4	11	9	9	18	9	9	18	13	17	22	

Source: High Speed Rail Authority's final business plan 2000.

Alternatives Comparison for Connectivity

No Project Alternative: Under the No Project Alternative, there would be no net improvement to the connectivity options in the state over the existing conditions. There would no new modes introduced, no new intermodal terminals or connections, and no improvements in air transportation frequencies.

Modal Alternative: Under the Modal Alternative, there would be significant capacity improvements to the air and highway system, but no new modes introduced into the system or intermodal facilities. The additional air capacity would likely result in additional frequencies between the airports where improvements were made. In particular, based on the assumptions for the Modal Alternative, air service between Fresno and the major metropolitan areas (Sacramento, the San Francisco Bay Area, Los Angeles, and San Diego) could be substantially improved where capacity exists.

High-Speed Train Alternative: The HST Alternative would add a new mode to the state's intercity transportation system. The HST would create a variety of new intermodal connections to local, regional, and intercity modes. The HST would add frequencies to the state's intercity travel network, allowing greater flexibility in travel time and location; however, this alternative could result in some decreases in air frequencies in some markets. Of all the alternatives, the HST Alternative provides the highest level of connectivity in the study area, particularly between the Central Valley cities and the city centers of the major metropolitan areas.

Sustainable Capacity

Sustainable capacity is a measure of the transportation capacity of an alternative to meet not only the projected demand but to provide a sustainable capacity over time without the need to develop additional infrastructure. Sustainable capacity is quantitatively measured by the amount of additional transportation infrastructure required to accommodate potential future demand beyond the demand forecast for this system.

For this analysis the design demand is assumed to be the 283 million annual intercity trips by 2020,[11] and both the Modal and HST Alternatives have been developed to accommodate this demand. To test the sustainable capacity of the Modal and HST Alternatives, a theoretical system capacity to accommodate potential additional demand was identified. For the purposes of this analysis, the system capacity is assumed to be approximately 31,500 passengers per hour, which represents a reasonable capacity for a 2-track HST system.[12] The ability of any of the alternatives to accommodate the hypothetical capacity is evaluated by region in terms of capacity on intercity transportation facilities (i.e., 31,500 passengers per hour on the intercity highway segments, airports, or HST for the Bay Area to Merced region) and used as a benchmark to compare the sustainable capacity of No Project, Modal, and HST Alternatives. A description follows of how the theoretical sustainable capacity was developed for each mode and for each alternative.

Highway Mode Characteristics: The sustainable capacity of a highway facility depends largely on the availability of travel lanes and the speed that autos are able to travel. This relationship is expressed as LOS, which is defined in Section 3.1, *Traffic and Circulation*. While all modes are subject to capacity constraints that affect the vehicle's speed, given the small capacity of most

[11] This demand includes the baseline demand of 215 million annual intercity trips and the 58 million high-end representative intercity demand trips. Not included in this analysis are 10 million commute trips.

12 The figure 31,500 represents 75% of 42,000 passengers per hour. The 42,000 passengers per hour is based on a train separation of 3 minutes between trains and a train capacity of about 1,050 passengers per train for both directions on a double-track system. Trains could be designed with more seating and can accommodate standing passengers if needed and therefore could exceed 42,000 passengers per hour.

automobiles (five passengers), more vehicles are required to accommodate a large passenger demand. To meet a higher travel demand, automobiles have two basic options for increasing capacity.

- Vehicle size may be increased (buses): the higher the capacity of the vehicle, the more passengers can be carried at a high rate of speed, and this assumes or requires a change in typical driver behavior.
- Capacity of the roadway may be increased (highway expansion): the addition of lanes allows more autos to travel safely with sufficient stopping distance.

The capacity of an intercity highway lane has been assumed to be 2,300 vehicles per hour with an average auto occupancy rate of 2.4 passengers per intercity vehicle trip, or about 5,520 intercity passengers per hour per lane per direction. Under the No Project and Modal Alternatives, where travel demand is split primarily between the auto and air modes, the highway demand would be 86%[13] of the total 31,500 passengers per hour, or approximately 27,100 passengers per hour in two directions (or 13,500 passengers per direction). Based on an average intercity vehicle occupancy rate of 2.4 passengers per vehicle, 13,500 passengers per direction is equivalent to an additional 5,600 vehicles per direction in addition to the future 2020 peak hour traffic demand. To accommodate the theoretical system capacity, on average[14] every highway link in the study area in all regions would require three additional highway lanes in each direction above and beyond what is proposed under the No Project Alternative. For the Modal Alternative, two additional highway lanes in each direction above and beyond what is proposed would be needed to accommodate the theoretical system capacity. No additional lanes would be required for the HST Alternative because the additional travel demand could be shifted from the highway system to the HST system.

Air Mode Characteristics: The sustainable capacity of an air travel system depends on both the airport and the aircraft. The capacity of an airport includes both airside (e.g., terminals, gates, runways, taxiways, and airspace) and landside (e.g., curbsides, roadways, and parking spaces) systems and facilities. Typical commercial aircraft can range between small jets such as regional jets and Boeing 737s with passenger capacities of 20 to 135, and large jets such as Boeing 777s and 747s with passenger capacities of 200 to 350. As presented in Chapter 2, *Alternatives*, this analysis assumes the Boeing 737 with a seating capacity of 135 will be the typical aircraft used for the intercity market within California.

It is possible to increase the capacity of the air travel system either by increasing the capacity of individual aircraft or by using more small aircraft and by expanding airports. However, for the air travel system to function properly, all systems must be in balance to avoid bottlenecks and unnecessary congestion. For instance, while it is possible to use larger aircraft at all of the airports considered in this analysis, it is necessary that the airside and landside systems be sized to adequately accommodate the additional demand.

Average runway and gate capacity was used to estimate the sustainable capacity of airports. Determining peak-period runway capacity typically requires sophisticated computer simulation techniques and considers the number of runways and their physical relationship to each other for each airport (crossing runways have less capacity then parallel runways, and capacity is further reduced during inclement weather), and the aircraft types that operate during the peak period.

[13] Based on mode splits forecast for 2020 conditions by Charles River Associates 2000.

[14] Some areas, such as along I-5 between Bakersfield and Los Angeles, did not require additional lanes, as two lanes per direction would be added under the Modal Alternative; others, such as SR-58 and SR-14, required two additional lanes.

Consistent with the approach used for the Modal Alternative, the same ratios (i.e., 525,000 passengers per gate per year and 30 gates per runway) were used to calculate the additional gates and runways required to accommodate the theoretical demand. Similar to estimating the number of highway trips, the total number of air trips are estimated at 4,100 air trips per hour per region, based on the forecasted mode split of 13% of air trips[15] (see Chapter 2).

The addition of 4,100 peak hour trips to each of the regions would require, on average, 51 gates and one runway in each region in addition to the improvements proposed under the Modal Alternative.[16] However, since major urban areas such as the Los Angeles region and the Bay Area have several airports with multiple gates and runways, it is reasonable to expect that those regions could accommodate some of the peak demand with operational improvements. Since interstate and international flights are also competing for the additional slots, any growth in intrastate flights would require additional gate and runway capacity improvements. In the regions with fewer airport options such as the Northern and Southern Central Valley and San Diego, where the gate and runway capacity simply does not exist, additional gates and runways would be needed above and beyond the Modal Alternative's additions. No additional gates or runways would be required for the HST Alternative because the shift of demand from the air system to the HST system would allow airports to handle the peak demand without additional capacity.

High-Speed Train Mode Characteristics: Sustainable capacity of an HST system is determined by the attributes listed below.

- Capacity of rail line (e.g., single track or double track).
- Capacity of the train (number of trainsets, or locomotives and coaches).
- Capacity of stations and passenger facilities, and the lengths of platforms.
- Speed at which the train can travel.
- Train control system.
- Degree that shared-use track is used by other services, thereby reducing available capacity of the HST.

The HST Alternative is a double-track system that allows trains to travel in each direction without having to stop to meet and pass each other. The HST Alternative also incorporates off-line stopping tracks at stations, allowing through trains to pass local trains. The double-track system could sustain a theoretical line capacity of 31,500 passengers per hour without any additional guideway; however, the size and number of trains operating per hour would increase, and the support facilities (e.g., maintenance and storage yards and stations) may have to be sized accordingly. The HST line capacity of 31,500 passengers per hour is based on the design characteristics of the proposed HST system and the following assumptions.

- Trains will be separated by 3 minutes.

[15] Based on mode splits forecast for 2020 conditions by Charles River Associates 2000.

[16] Based on 4,100 passengers per hour, multiplied by an 18-hour operating day, multiplied by 365, which equals 26,937,000 annual trips.

- The capacity of a train will be about 1,050 passengers with a load factor of 75%.
- Traffic will reach 40 trains per hour (both directions on a double track system).

Train capacity can vary depending on the number of cars and how the seats are configured in those cars. The trains can even accommodate standees if the demand exceeds seating capacity. Station platforms need to be the same length as the total length of the train. In this case the train and platforms are designed for a maximum length of more than 1,300 ft (400 m). The train control system is one of the ultimate determinants for speed on the train system, and is assumed to be adequate for the additional capacity (Nash 2003). The train control system is responsible for safely spacing the trains so that there is adequate stopping distance between the trains. While the train control system requirements will determine the ultimate safe traveling speed for the train, the design speed of the train also affects the capacity of the system as a whole. All of these factors play a role in determining the sustainable capacity of an HST system.

In California, conventional rail largely depends on the capacity of the host railroads, which are primarily freight railroads and commuter rail authorities. Amtrak, the current intercity operator, does not own any tracks or have dispatch control in the state. Since conventional rail, especially intercity passenger rail, is a tenant on the host railroads, the ultimate capacity of the line is not in their direct control. Infrastructure conditions, freight demand, and commuter rail demand all play a role in determining the capacity of the railroad. Currently there are considerable capacity constraints in southern California in the Los Angeles area and between Sacramento and San Jose in the Bay Area. Because of these severe capacity constraints in the state, conventional intercity passenger rail has very limited sustainable capacity.

Alternatives Comparison for Sustainable Capacity

No Project Alternative: There is little to no sustainable capacity in the No Project Alternative. The future transportation infrastructure is severely constrained by the limited number of capacity improvements funded or programmed for 2020. Improvements associated with the No Project Alternative are generally to existing interchanges versus line capacity expansion or improvement projects. The highway system's sustainable capacity would require additional infrastructure to accommodate any growth in demand. To accommodate the theoretical system capacity of 31,500 passengers per hour, the highway system would require at least three additional lanes in each direction. The capacity of airports would have to be expanded somewhat more than improvements contemplated under the Modal Alternative. Therefore, the No Project Alternative would not accommodate the theoretical demand and would require extensive infrastructure expansion to have sustainable capacity.

Modal Alternative: There is insufficient capacity in the Modal Alternative to accommodate the additional theoretical demand in all regions. Additional highway and airport infrastructure beyond the Modal Alternative improvements would be required to accommodate the 31,500 peak passenger demand theoretical system capacity. While the Modal Alternative would include some excess highway and airport capacity in the potentially modified highway and airport system, it would not be sufficient in all areas to meet the additional demand and overall service levels would be degraded with use beyond the representative demand. Where the Modal Alternative would provide excess capacity (e.g., capacity gained through addition of a full lane), the capacity would probably be absorbed by other travelers (e.g., commuter or other trips). Additional capacity for highways and airports might be further increased with either higher auto occupancy rates or larger aircraft, respectively. However, auto occupancy rates are not likely to change on a statewide level.

Likewise, the prevailing trend in the aviation industry and projections for future aircraft operations are toward a greater reliance on small and regional jet aircraft (up to 135 passengers)

compared to large aircraft for the short-haul intercity travel market under evaluation for this study. Additionally, if larger aircraft were used, landside improvements would still be required to accommodate demand. In both cases, it is important to note that without capacity increases through either lane widenings or additional runways and gates, service levels would worsen for both modes because in both cases performance is contingent on available capacity.

High-Speed Train Alternative: The HST Alternative would provide a train system with sufficient infrastructure to meet the projected demand and to allow for capacity expansion beyond the design year requirements. It would provide an additional mode for the state's intercity transportation system, effectively creating a capacity release valve for the existing intercity modes. The ultimate capacity of the HST could exceed the forecasted 20- to 40-year demand by increasing frequency of service, adding cars to trainsets, using double-deck passenger cars or linking multiple trainsets together on the proposed dual-track system. In addition, the HST Alternative presents a reasonable alternative to expanding highway and aviation infrastructure. Compared to the No Project and Modal Alternatives, the HST Alternative would require no additional infrastructure (with the exception of rolling stock, stations, and maintenance facilities) to provide substantially additional capacity; therefore, the HST Alternative would have the highest sustainable capacity.

Passenger Cost

Passenger cost is a measure of the relative differences in travel costs between the No Project, Modal, and HST Alternatives. Passenger cost for this analysis means the total cost of the trip, including the cost of traveling to the airport or station, the airplane or train fare, and other associated expenses. Cost is one of the key factors that can influence passenger choice of modes.

There is a range of existing intercity travel options, from relatively inexpensive intercity bus to premium air. For example, the cost of traveling round-trip between Los Angeles and San Francisco (one of the busiest travel corridors in the world) can be as little as $25 for an intercity bus ticket to as much as $350 for a walk-up fare for airline travel. The air travel market particularly features large variations in fares. Sources of these variations include the following factors.

- Time of travel: Peak-period travel tends to be more expensive, and Saturday night stays tend to be less expensive.
- Time of booking: Early bookings tend to be less expensive, while last-minute bookings are more expensive.
- Airport choice: Travel between major destinations such as Los Angeles and San Francisco boasts a variety of options and fares, while travel to or from smaller airports with limited service such as Fresno and Bakersfield have greatly limited fare and travel choices.

Passenger cost is quantitatively measured by actual costs to the passenger associated with a typical door-to-door trip. The representative city pairs presented in the travel time discussion earlier in the section are used as a basis to compare the relative differences in cost

Automobile Mode Characteristics: For highway travel, it is assumed that the entire door-to-door trip is made with a private automobile and that there are no ancillary access costs. Automobile travel costs are shown as the total costs per passenger and per auto. The total costs of owning and operating a vehicle include depreciation, maintenance, repairs, taxes, insurance, etc. and are shown on a per-auto basis in Table 3.2-17. The ridership and revenue estimates for the Business Plan are based on the perceived costs of making an automobile trip (e.g., fuel) and do not include all of the true costs associated with owning and operating a vehicle.

Table 3.2-18 summarizes the costs for making a one-way trip for the representative city pairs. Parking is not included even though this could be an additional significant expense. (All-day parking in downtown San Francisco or Los Angeles can be as high as $25.) As shown in the table, the door–to-door average perceived one-way cost per person for traveling between representative city pairs by highway range from $15 to $48 per passenger, and $25 to $81 for total costs.

Table 3.2-17
Auto Ownership and Operating Costs by Category (2003$)[a]

Cost Category	Percent of Cost	Cents
Financing	15	7.7
Depreciation	35	18.0
Fuel Tax	4	2.0
Fuel	9	4.6
Repairs	2	1.0
Maintenance	5	2.6
State Fees	3	1.5
Insurance	27	13.8
Total	100	51.2

[a] All costs escalated by 3% for 3 years to calculate 2003 dollars.
Source: Federal Highway Administration, Our Nation's Highways, 2000.

Table 3.2-18
One-Way Door-to-Door Trip Automobile Costs (2003$)[a,b]

City Pair	Average Total Cost per Passenger[c]	Total Costs per Auto[d]
Los Angeles downtown to San Francisco downtown	$81	$194
Fresno downtown to Los Angeles downtown	$47	$112
Los Angeles downtown to San Diego downtown	$25	$61
Burbank (airport) to San Jose downtown	$70	$169
Sacramento downtown to San Jose downtown	$25	$60

[a] California High Speed Rail Authority Business Plan cost numbers. HST ridership forecasts assumed only perceived auto costs. Average cost does not include parking.
[b] All costs escalated by 3% for 3 years to calculate 2003 dollars.
[c] Total cost based on average cost of owning and operating a vehicle of 51 cents per mile divided by the assumed average auto occupancy rate of 2.4 persons. Source: Federal Highway Administration, Our Nation's Highways, 2000.
[d] Full cost of driving a single-occupant auto based on average cost of owning and operating a vehicle of 51 cents per mile.
Source: Federal Highway Administration, Our Nation's Highways, 2000; Parsons Brinckerhoff 2003.

Air Mode Characteristics: The passenger cost of air travel is primarily determined by the available fare. Depending on the airport, airline, time of year, day of the week, and even certain hours of the day, the price of an air ticket can vary greatly. Regions with competing airports or alternative sub-markets (i.e., Ontario and Oakland) have more fare, schedule, and airline options compared to airports with limited service (e.g., Fresno and Bakersfield). In California, since most

air operations are scheduled to serve longer distance markets, some major airports such as San Francisco and Los Angeles have a more limited choice of airlines and fare options for intra-California travel. Airports that provide more limited service, such as Fresno and Bakersfield, typically have only a few flights available per day and typically one or two airlines that serve that market. However, airports like Ontario and Oakland have frequent intra-California flights from a range of airlines at highly competitive fares.

Average total air costs were calculated as including access, egress, and airfare costs. The access and egress sum cost ranges from $10 to $24 per trip. Air trips require at least one other mode to travel from a different location (e.g., home/office) to the airport, which may include public transit (bus or rail), taxi/shuttle, or private auto (may require parking or drop-off).

A range of airfares are available that depend on time of purchase (e.g., 21-day advance purchase versus same-day fare), duration of visit (e.g., same-day or Saturday night stay), and departure time (e.g., peak versus off-peak). Table 3.2-19 summarizes the average total cost for air travel between city pair destinations based on the Business Plan estimates (escalated to 2003 dollars) for business and non-business travel.. As shown, airfares vary widely and can range from $94 between Burbank and San Jose to $224 between Sacramento and San Jose for business travel.[17]

Table 3.2-19
Average Business and Non-Business Fares One-Way Door-to-Door Air Trip Passenger Costs (2003$)[a]

City Pair	Average Total Costs[b] Business/Non-Busiiness
Los Angeles downtown to San Francisco downtown	$148/$89
Fresno downtown to Los Angeles downtown	$193/$112
Los Angeles downtown to San Diego downtown	$148/$89
Burbank (airport) to San Jose downtown	$94/$54
Sacramento downtown to San Jose downtown	N/A

[a] Based on low-end revenue and ridership forecasts from the Business Plan. Costs are escalated by 3% for 3 years.
[b] Sample costs include fares as well as parking, taxi fares, and other costs involved with traveling to and from the airport.
Source: Parsons Brinckerhoff 2003.

High-Speed Train Mode Characteristics: Similar to air travel, the primary cost associated with HST travel is the cost of the train ticket. For this analysis, the fare schedule identified in the Business Plan (escalated to 2003 dollars) was used to compare the representative city pairs (Table 3.2-20). However, based on experience in Asia and Europe, HST fares may vary the way airfares do with the time of year, day of week and duration of stay. New competition may also develop between the different modes that may affect HST fares. The HST could also offer premium and economy services with corresponding fares depending on the markets that develop.

As with air travel, both an access and egress fee of about $5 or $6 ($10 to $12 total) are part of the HST average total costs. HST travel requires at least one mode change to access the nearest HST station. Because the HST stations are generally located in the city centers they are assumed

[17] There is no direct air service between Sacramento and San Jose; therefore it is assumed that this trip would be between SMF and SFO with a shuttle connection to San Jose.

to be located in closer proximity to larger population and work centers than airports. The HST line-haul travel fare was estimated by using the fare schedule presented in the Business Plan (escalated to 2003 dollars).

Table 3.2-20
High-Speed Train One-Way Door-to-Door Trip Passenger Costs (2003$)[a]

City Pairs	Average Total Cost[b] Business/Non-Busiiness
Los Angeles downtown to San Francisco downtown	$59/$35
Fresno downtown to Los Angeles downtown	$50/$31
Los Angeles downtown to San Diego downtown	$47/$29
Burbank (airport) to San Jose downtown	$52/$31
Sacramento downtown to San Jose downtown	$48/$29

[a] Based on business fare costs provided in Business Plan.
[b] Sample costs include fares as well as parking, taxi fares, and other costs involved with traveling to and from the airport.
Source: Parsons Brinckerhoff (2003).

Depending on city pair, level of state support for fare subsidies, and competition, intercity passenger rail would be cost-competitive with the HST. On average, given current fares for Amtrak service and the proposed fares for HST, conventional intercity service would cost approximately 10% less than the HST for the representative city pairs listed above (assuming the same access and egress fees as the HST). Conventional rail would also be considerably less expensive than air based on the representative city pairs.

Alternatives Comparison for Passenger Costs

No Project Alternative: Overall, auto passenger costs are considerably lower for short- and mid-range trips than airfares for short haul routes, such as Los Angeles to San Diego, Los Angeles to Fresno or Sacramento to San Jose. For long-range trips, such as Los Angeles to San Francisco or Burbank to San Jose, the automobile remains competitive due to the access and egress costs associated with air travel.

Modal Alternative: Because no additional mode options are included in the Modal Alternative, passenger costs would be, on average, equal to those of the No Project Alternative. The same passenger cost analysis of short-, mid-, and long-range trips of the No Project Alternative pertains to the Modal Alternative.

High-Speed Train Alternative: The HST Alternative would provide an overall passenger cost savings for all city pairs analyzed. On average, the HST Alternative could save from 8% to 44%, depending on city pair, of the passenger costs associated with the No Project and Modal Alternatives. The HST mode is cost-competitive with the highway mode for all trips and is less expensive than the air mode. For all city pairs, the HST Alternative provides a price-competitive alternative to existing airline service and the automobile.

3.2.4 High-Speed Train Alignment Options Comparison

Travel time, connectivity and passenger cost for the HST can all be affected by which alignment option the HST travels on. This section discusses the relative differences by region of the alignment options for the HST Alternative.

A. BAY AREA TO MERCED

The selection of the Diablo Range direct options between the San Francisco Bay Area and the Central Valley would have significant implications for HST service. The Diablo Range direct alignments are a shorter and faster option between the San Francisco Bay Area and Sacramento/Northern San Joaquin Valley, providing for much shorter travel times between these markets. For example, for express trains between Sacramento and San Jose, the Diablo Range direct alignments travel times would be about 25 min less than for the Pacheco Pass (50 min for the Diablo alignments verses 1 hr and 15 min for the Pacheco Pass options). The Diablo Range direct options would permit express travel times between Sacramento and San Francisco in 1 hr and 20 min, compared to 1 hr and 45 min via the Pacheco Pass options.

The Diablo Range direct alignments would place Merced on the San Francisco to Los Angeles segment of the HST network, which would result in a higher frequency of service to/from Merced. However, the Pacheco Pass alignment options include potential stations at Gilroy (or Morgan Hill) and Los Banos, whereas the Diablo Range alignments do not have any stations between Merced and San Jose. The populations that would be served by the Gilroy and Los Banos stations would therefore have much shorter access times and access costs to the nearest HST station with the Pacheco Pass alignments. The potential Gilroy/Morgan Hill Station would have a particularly high impact on connectivity, travel times, and access costs, since in addition to serving Southern Santa Clara County, it would also be the most accessible station location for serving the Santa Cruz, Monterey/Carmel, and Salinas populations.

The decision on how best to serve the Bay Area cities would also have a major impact on the HST system. This Program EIR/EIS evaluates both potential service to the Bay Area along the San Francisco Peninsula and potential service along the East Bay to Oakland. If service to both sides of the Bay were pursued, service to each Bay Area station (north of San Jose) would be less frequent. However, if only one side of the Bay were directly served by the proposed HST system, the number of intermodal connections would be greatly reduced. The access times and access costs would increase significantly, and the competitiveness of the new mode on the side of the Bay not served would also be reduced. For example, if the East Bay is not directly served, all trains bound for the Bay Area would terminate in downtown San Francisco. However, there would be no HST link to directly serve Oakland, the Oakland Airport, or Southern Alameda County. Potential HST passengers from the East Bay would have to either use the Capitol Corridor, mass transit, or drive to San Francisco, San Jose, or the Peninsula to use the HST service.

The I-880 alignment would provide superior travel times to connect the HST system to the East Bay as compared to the Hayward/Niles/Mulford Line. The Mulford Line is a longer route and has tight curves that would severely restrict speeds between Fremont and Union City. For all potential markets to Oakland, the I-880 corridor would offer express and local travel times of about 6 min less than the Mulford Line. Using the I-880 corridor, travel times between Oakland and Los Angeles could be achieved in 2 hrs and 18 min, whereas using the Mulford Line the same trip would take a minimum of 2 hrs and 24 min.

<u>Potential Station Locations</u>

- For service to downtown San Francisco, the Transbay Terminal and the 4th and King Station were selected for further evaluation. The 4th and King Station is the existing terminus for

the Caltrain commuter rail service. This station site (adjacent to Pacific Bell Stadium) is well connected to the San Francisco Muni system but stops more than a mile short of the financial district of downtown San Francisco and does not connect to BART. The Transbay Terminal would offer significantly greater connectivity to San Francisco and the greater Bay Area than the existing 4th and King site due to its location in the heart of the downtown San Francisco financial district, where many potential HST passengers could walk to the station. In addition, the Transbay Terminal would serve as the transit hub for all of the major services to downtown San Francisco, with the advantage of direct connections to BART and Muni. The 4th and King Station would have about a 2.5-min shorter line-haul travel time to San Francisco than the Transbay Terminal, since the trains would travel at relatively slow speeds between 4th and King and the Transbay Terminal, a distance of 1.2 mi (1.9 km). However, since the Transbay Terminal would offer much greater connectivity to San Francisco and the greater Bay Area than the existing 4th and King site, total travel times to downtown destinations via the Transbay Terminal are expected to be superior.

- West Oakland Station and 12th Street City Center Station were selected for further consideration for the Oakland terminus station. Both of these potential stations would directly connect with BART, and both would have good freeway access. The 12th Street City Center Station would have superior connectivity, as it is located in the heart of downtown Oakland where many potential HST passengers could walk to the station. The 12th Street City Center BART Station is also a transfer station providing greater connectivity to the regional rail transit system.
- A potential station to serve San Mateo County would be located either at Redwood City or Palo Alto. Both would be multi-modal stations at existing Caltrain station locations. The Palo Alto Station would be a stop for the Caltrain express services, and therefore would have better connectivity to the regional commuter service and to the Peninsula.
- A potential station to serve Southern Alameda County would be located at either Union City or Fremont (Auto Mall Parkway). Both station locations would offer a high level of connectivity. The Union City Station would connect to BART, the Capitol Corridor, and AC Transit; whereas the Auto Mall Parkway Station would have good access to the I-880 freeway and connect to the Capitol Corridor, ACE Commuter Rail, and AC Transit. The Union City Station site serves both alignment options for East Bay service, while the Auto Mall Parkway site is only served by the Mulford Line alignment.
- South Santa Clara County potentially would be served by a station at either Gilroy or Morgan Hill. Both of these two potential stations would be at Caltrain commuter rail station locations. The Gilroy Station is about 10 mi (16 km) south of Morgan Hill and therefore provides better connectivity, travel times, and lower access costs to the Santa Cruz, Monterey/Carmel, and Salinas markets. The Gilroy Station is only served by the Pacheco Pass/Gilroy/Caltrain alignment, and neither the Gilroy nor the Morgan Hill station sites would be served by the Diablo Range Northern alignment options.
- Four other potential stations are being considered for service to the Bay Area: Diridon Station in downtown San Jose, and stations to serve the three regional international airports, SFO, Oakland (Coliseum BART), and San Jose (Santa Clara). In addition, a potential station in the Central Valley to serve Los Banos is being considered for the Pacheco Pass alignment options. Diridon Station would be a multi-modal hub maximizing connectivity to downtown San Jose and the Southern Bay Area. Diridon Station would serve Caltrain, ACE Commuter Rail, the Capitol Corridor, Amtrak, VTA buses and light rail, and a possible link to BART. None of the three airport stations would be in the airport terminals, but each would permit easy access by people movers, or shuttles (at SFO, BART currently provides a direct connection from the Millbrae Caltrain Station to the SFO international terminal). All three potential airport stations would have direct connections to local and regional commuter rail

services and would minimize potential travel times and costs for HST passengers who would use the trains for access to the airports. The potential Los Banos Station would be north of the city of Los Banos with good accessibility to I-5 and would greatly reduce travel times and access costs to that population.

B. SACRAMENTO TO BAKERSFIELD

Between northern and southern California, the UPRR rail alignment is slightly more direct than the BNSF rail alignment, about 4 mi (6 km) less distance when measured from the BNSF and UPRR merge point, which is 2.3 mi (3.7 km) south of the Truxton Station on the BNSF and 3.6 mi (5.8 km) south of Bakersfield Golden State Station on the UPRR. However, since maximum speeds would be achieved throughout the Central Valley, the differences in travel times between northern and southern California would be marginal, with the UPRR providing potential travel times about 2 min less than the BNSF. The UPRR and BNSF rail alignments would serve the same populations and same number of potential stations. Therefore, the selection of the Central Valley alignment would not have an overall impact on Central Valley connectivity. Most of the potential stations locations throughout the Central Valley can be served by either the BNSF or the UPRR, and the preferred Central Valley alignment could even be a combination of these two existing freight rail corridors. The potential Modesto stations and potential station at either Hanford or Visalia are the exceptions, where the selection of the alignment (between Stockton and Merced for the Modesto Station and between Fresno and Bakersfield for Hanford/Visalia) would determine the potential station location since there are no practical connections between the UPRR and BNSF at these locations.

Potential Station Locations

- The Downtown Sacramento Valley Station would have better connectivity in Sacramento than the Power Inn Road Station location. The Valley Station is located in downtown Sacramento and is within walking distance of the state capitol. This multimodal station location serves the existing Amtrak services to Sacramento, including the Capitol Corridor, and will serve the Sacramento Light Rail Train (LRT) that is being extended to this station site. This site also has good access to I-5. Although the Power Inn site has good intermodal access to the Sacramento LRT and to US-50, it is located outside of downtown Sacramento, more than 5 mi (8 km) away from the state capitol. The Power Inn Station would have about a 3-minute shorter line-haul travel time to Sacramento then the Downtown Sacramento Valley Station, since the trains would travel at relatively slow speeds between Power Inn and the Valley Station, a distance of about 7.5 mi (12.1 km). However, the Sacramento Valley Station would offer greater connectivity to downtown Sacramento and the Sacramento region, and shorter total travel times to downtown destinations.
- Two potential station sites are evaluated to serve Modesto: a potential downtown station on the UPRR rail alignment, and the existing Amtrak Briggsmore Station on the BNSF alignment. The downtown station maximizes connectivity to downtown Modesto and provides convenient access to SR-99, whereas the Amtrak Briggsmore Station is about 5 mi (8 km) east of downtown Modesto. As noted above, the selection of the alignment between Stockton and Merced would determine the station site for Modesto.
- To serve Merced, potential station locations are evaluated at downtown Merced along the UPRR alignment, at Castle Air Force Base, and at the Merced Municipal Airport. The downtown station is located near the city center and transit hub of Merced, has good access to SR-99, and would have the highest level of connectivity of the three locations. The Castle Air Force Base site is about 7 mi (11 km) from downtown Merced, but would provide easy access to the developing University of California, Merced campus via a new highway alignment along Bellevue Avenue. The Merced Municipal Airport site would be less than 2 mi (3 km) from downtown Merced.

- Potential station sites in Tulare and Kings Counties are evaluated at Hanford and Visalia. The ultimate selection of an alignment between Bakersfield and Fresno would include the determination of station location. The Hanford site would connect to the Amtrak station in Hanford, whereas the Visalia Airport Station would best serve the more populated Tulare County cities of Visalia and Tulare. The BNSF serves Hanford and would result in faster travel times and lower access costs for Hanford residents and Kings County; the UPRR serves Visalia and would result in faster travel times and lower access costs for the Visalia population and Tulare County.
- The Truxton Station would have the highest connectivity of the three locations being evaluated to serve Bakersfield. The Truxton Station would connect to the new Bakersfield Amtrak Station and is in the city center of Bakersfield, within walking distance to the convention center and city hall. The Truxton station location also has good access to SR-99. The Golden State Station site is less than 2 mi (3 km) northeast of the city center next to SR-204. The Bakersfield Airport Station would be located outside of Bakersfield about 6 mi (10 km) northeast of the city center. The airport station would provide a high level of connectivity to the airport and has good access to SR-99.
- Two other potential stations are considered for Central Valley service, the ACE Stockton Downtown Station and Downtown Fresno Station. Both of these stations would maximize connectivity to downtown Stockton and to downtown Fresno. The ACE Stockton Station is the current terminus for the ACE Commuter Rail to San Jose and is located in the central part of Stockton. The Downtown Fresno Station is close to the city center and has convenient access to SR-99, SR-41, and SR-180 freeways.

C. BAKERSFIELD TO LOS ANGELES

The selection of the southern mountain crossing alignment option between Bakersfield and Los Angeles would have implications for the HST system and have an effect on the travel times between northern and southern California. The I-5 alignment would have express times about 10 min less than the SR-58/Soledad Canyon alignment, and local times about 12 min less. For example, the San Francisco to Los Angeles express travel time would be less than 2 hrs and 25 min for the I-5 alignment and just over 2 hrs and 35 min for the SR-58/Soledad Canyon alignment. The SR-58/Soledad Canyon alignment option includes a potential station at Palmdale, whereas the I-5 alignment does not have any stations between Bakersfield and Sylmar. The potential Palmdale Station would have a particularly high impact on connectivity since it would serve the growing communities of the Antelope Valley. The SR-58/Soledad Canyon alignment would also improve travel times and reduce access costs to and from the Antelope Valley population.

Between Sylmar and Los Angeles, the combined I-5/UPRR alignment would be shorter and have fewer speed-restricting curves than the UPRR/Metrolink alignment, resulting in travel time saved of about 1 min.

Potential Station Locations

- There are three station sites within the vicinity LAUS: LAUS, Union Station South, and Los Angeles River East. Of the three potential sites, the existing LAUS station has the best connectivity and therefore would also provide the fastest overall travel times to many destinations. LAUS is the transit/rail transportation hub of southern California. LAUS is the primary destination for the Metrolink commuter rail services, the Los Angeles Metro Red Line, the Pasadena Gold Line, the Amtrak Surfliner service, and the regional bus transit services. HST would serve LAUS on an elevated structure where transfers to other modes would be made directly under the HST platforms. The Los Angeles River East Station and Union Station South sites would require the construction of a pedestrian bridge/plaza across the US-101 freeway to connect with LAUS.

- The Palmdale Transportation Center is being considered as a potential station site for serving the Antelope Valley population. The Palmdale Transportation Center maximizes opportunities for intermodal connectivity. It is close to Palmdale Airport, with the opportunity for convenient shuttle or people-mover connections. The transportation center is the Metrolink Station for Palmdale and is a hub for local bus services. The Palmdale Transportation Center would provide short travel times and low access costs for the Antelope Valley population.
- The Sylmar Metrolink Station would provide a direct connection to the Metrolink regional commuter rail service and would have convenient access to the freeway network.
- The Burbank Metrolink Station would provide the highest connectivity to the Burbank area. This station site is in downtown Burbank, has a direct connection to the Metrolink regional commuter rail service, is a hub for bus transit in the Burbank area, has adjacent access to I-5, and is only 2.4 mi (3.9 km) from Burbank Airport. The Burbank Airport Station would be nearer to Burbank Airport at 1.6 mi (2.6 km) away, but would be outside the city center and does not connect with a Metrolink station or regional transit.

D. LOS ANGELES TO SAN DIEGO VIA INLAND EMPIRE

Between Los Angeles and Riverside, the UPRR Riverside and UPRR Colton rail alignments would serve the same populations and same number of potential stations, whereas the alignment options for either the UPRR Riverside or UPRR Colton that would directly serve the city center of San Bernardino and would offer greater connectivity with freeway, commuter rail, and local transit. Using the San Bernardino alignment would add between 4 min and 8 min to the travel time between Los Angeles and March ARB.

Decisions concerning how a proposed HST system would best serve San Diego would have implications for the HST system and its operations. The Miramar Road and Caroll Canyon alignment options would have considerable connectivity advantages over the Qualcomm alignment option. The Miramar Road alignment and the Carroll Canyon alignment options would directly serve downtown San Diego, while the Qualcomm Stadium Station would be about an 8-mi (13-km) drive or 10-mi (16-km) light rail ride to the city center. In addition, the Miramar Road and Carroll Canyon alignment options would provide an alternative to the potential Mira Mesa Station at University City.

The I-15 alignment to Qualcomm Station would have the shortest line-haul times (about 7 min less than the two options to downtown San Diego), but would not directly serve downtown San Diego. The line-haul time for the LRT between Qualcomm and the downtown San Diego Santa Fe Depot is more than 20 min long. The Miramar Road and Carroll Canyon alignment options would therefore be expected to provide considerably superior total travel times to downtown San Diego than the I-15 alignment to Qualcomm Stadium. Decisions on how best to serve San Diego with a proposed HST system could also impact total HST passenger costs for service to or from San Diego. The Miramar Road and Carroll Canyon alignment options that would serve downtown San Diego would be expected to have lower access costs to downtown San Diego than the I-15 alignment to Qualcomm Stadium.

<u>Potential Station Locations</u>

- Of the four potential stations sites serving East San Gabriel Valley, the Metrolink station sites at Pomona and City of Industry would have the widest range of multimodal connections to local and regional bus services, and to Metrolink commuter rail service. The City of Industry site would provide a more central location between the potential stations at LAUS and Ontario Airport. All of the potential station sites would have good access to the freeway network. The Pomona station area would be served by both the UPRR Colton and UPRR Riverside/Colton alignment options, whereas the El Monte station and City of Industry sites are on the UPRR Colton alignment and the South El Monte station on the UPRR Riverside

alignment. The City of Industry site would provide a more central location between the potential stations at LAUS and Ontario Airport and therefore the lowest overall travel times.

- Of the four potential stations sites serving the Riverside/San Bernardino area, the San Bernardino Metrolink Station site would have the widest range of multimodal connections to local and regional bus services and to Metrolink commuter rail service. The UPRR Colton Station site would have the least connectivity to existing transit services, but would have the most central location for serving both the San Bernardino and Riverside populations and have good accessibility to I-10. The University of California, Riverside (UCR) site is furthest away from the freeway network but provides for the most convenient access to Riverside. Service to the San Bernardino Metrolink Station would provide the most convenient access to San Bernardino. The March ARB site would be adjacent to the airport, but would have the least connectivity, longest travel times, and highest access costs since the airport does not serve commercial air passengers and this site is furthest away from the Riverside/San Bernardino populations.
- For service to San Diego, the Downtown San Diego Santa Fe Depot site would have the highest connectivity. This station is located in the city center where many potential HST passengers could walk to their destination. The Santa Fe Depot is the terminus for the Coaster commuter rail service, the Amtrak Surfliner intercity service, provides direct connections to the San Diego LRT network, and is a bus transit hub for San Diego. San Diego International Airport is a unique airport in that is located adjacent to downtown San Diego and is only about 2 mi (3 km) from the city center. The San Diego Airport Station location would provide a convenient connection to the international airport and directly connect with the regional bus network and a San Diego LRT station. Although the San Diego airport location would not have as good connectivity to the city center as the Santa Fe Depot site, it would have a better connection to I-5. Qualcomm Stadium would provide a direct connection to the San Diego LRT network and good freeway access, but it would not have the same level of connectivity to the San Diego city center.
- The Escondido Downtown Transit Center would have somewhat higher connectivity than the Escondido I-15 Station Site. The Downtown Transit Center Station would be closer to the Escondido Transit Center, within 0.13 mi (0.20 km), and provide better connectivity with the proposed Escondido to Oceanside commuter rail service, but the Escondido I-15 site would provide more convenient freeway access.
- The University City station site in San Diego is located near a densely developed portion of San Diego, which could be served by the Coaster commuter rail service, would be served by San Diego LRT, and would provide a higher level of connectivity than the Mira Mesa station location. However, the University City site is not served by the I-15 alignment option that serves the Qualcomm Station.
- Potential stations are also being considered at the Ontario airport and Murietta. The Ontario Airport Station would provide a multi-modal connection to Ontario International Airport and link to region bus transit services. The Ontario Airport Station would provide the fastest HST travel times and reduce access costs for passengers looking to make an air connection at Ontario International Airport. A potential station at Murietta would serve the fast-growing Temecula/Murietta area. The Murietta at I-15/I-215 Interchange Station site would have convenient freeway access to both I-15 and I-215.

E. LOS ANGELES TO SAN DIEGO VIA ORANGE COUNTY

Decisions on how proposed rail improvements may best serve this region would have major implications for the HST system and operations. The Authority is considering optional service to LAX and Orange County. If service to LAX and/or Orange County were selected, frequencies to each station along the Los Angeles to San Diego via Inland Empire corridor could be less than if a single

line south of Los Angeles were selected. However, if HST directly serves LAX and/or Orange County, the number of intermodal connections could be greatly increased. The travel times and access costs to these markets would be greatly decreased with the HST, and the competitiveness of the HST would be greatly increased for the southwest portions of Los Angeles County and/or Orange County intercity transportation markets. If the airport is not directly served, local transportation (shuttle, regional transit, or the automobile) would be needed between LAUS and the airport or to western Los Angeles County. For the link to Orange County, potential stations are being considered at Norwalk (southern Los Angeles County, serving the gateway cities), Anaheim, and Irvine. If Orange County is not directly served, passengers to southern Los Angeles County and Orange County would need to transfer to non-electric, conventional intercity rail Amtrak Surfliner service at LAUS.

The LOSSAN alignment between LAUS and Anaheim would provide a high level of connectivity with Metrolink, Amtrak Surfliner, and regional and local bus transit. However, because this alignment would require sharing tracks with existing services, it is severely constrained in terms of sustainable capacity and the potential frequency for HST service to Orange County. Operations models suggest that the HST operations may be limited to 18 to 45 trains per day (in each direction) to Orange County if the LOSSAN alignment is selected. In contrast, the UPRR Santa Ana alignment would be dedicated to HST service and would have the capacity to serve up to 20 trains per hour, but it does not provide direct connectivity to Metrolink or Amtrak.

Potential Station Locations

- South Los Angeles County could have a potential HST station at Norwalk either along the LOSSAN rail alignment or the UPRR Santa Ana alignment. The selection of the alignment between Los Angeles and Orange County would determine the preferred station location for serving the gateway cities of south Los Angeles County. The Norwalk LOSSAN site would be at Norwalk Metrolink Station with direct connectivity to the regional commuter rail service. This site is a bus transit hub for the area and is well served by I-5 and the Imperial Highway. The Norwalk UPRR site has no existing passenger rail connection, as it is located about 1 mi (1.6 km) east of the Green Line LRT terminus, but it has existing bus connections and good freeway access.
- Three other potential HST stations are being considered for this region: a potential station at LAX, and potential stations at Anaheim and Irvine to serve Orange County. The LAX station would be adjacent to the airport terminals and would permit easy access by a potential people mover, shuttle, or by walking. It would have direct connections to regional bus transit services and be the only HST station directly serving western Los Angeles County. The Anaheim Edison Field Amtrak Station and the Irvine Transportation Center are transit hubs with high connectivity for central and south Orange County respectively. These stations are OCTA bus transit hubs and serve existing Amtrak and Metrolink commuter rail services.

3.3 AIR QUALITY

This section provides an overview of the six air basins studied for this Program EIR/EIS and describes the composition of air pollutants in and the status of these air basins. In addition, this section describes the potential impacts that may directly and indirectly affect state and regional air quality under the No Project, Modal, and proposed High-Speed Train (HST) Alternatives, using the existing and No Project conditions for comparison.

Air pollution is a general term that refers to one or more chemical substances that degrade the quality of the atmosphere. Eight air pollutants have been identified by the U.S. Environmental Protection Agency (EPA) as being of concern nationwide: carbon monoxide (CO), sulfur oxides (SO_x), hydrocarbons (HC), oxides of nitrogen (NO_x), ozone (O_3), particulate matter 10 microns in diameter or less (PM10), particulate matter 2.5 microns in diameter or less (PM2.5) and lead (Pb). Except for HC (also referred to as total organic gases (TOG), all of these pollutants (NO_x in the form of NO_2 and SO_x in the form of SO_2) are collectively referred to as criteria pollutants. Pollutants that are considered *greenhouse gases* also affect air quality. Greenhouse gases include, NO_x, TOG, and carbon dioxide (CO_2). The sources of these pollutants, their effects on human health and general welfare, and their final deposition in the atmosphere vary considerably.

3.3.1 Regulatory Requirements and Methods of Evaluation

A. REGULATORY REQUIREMENTS

Federal Regulations

Air quality is regulated at the federal level under the Clean Air Act of 1970 (CAA) and the Final Conformity Rule (40 C.F.R. Parts 51 and 93). The Clean Air Act Amendments of 1990 (Public Law [P.L.] 101-549, November 15, 1990) direct the U.S. EPA to implement strong environmental policies and regulations that will ensure cleaner air quality. According to Title I, Section 101, Paragraph F of the Clean Air Act Amendments (42 U.S.C. § 7401 *et seq.*): "No federal agency may approve, accept, or fund any transportation plan, program, or project unless such plan, program or project has been found to conform to any applicable state implementation plan (SIP) in effect under this act." Title 1, Section 101, Paragraph F of the amendments, amends Section 176(c) of the CAA to define *conformity* as follows: conformity to an implementation plan's purpose of eliminating or reducing the severity and number of violations of the National Ambient Air Quality Standards (NAAQS) and achieving expeditious attainment of such standards; and that such activities will not cause any of the following occurrences.

- Cause or contribute to any new violation of any NAAQS in any area.
- Increase the frequency or severity of any existing violation of any NAAQS in any area.
- Delay timely attainment of any NAAQS or any required interim emissions reductions or other milestones in any area. (42 U.S.C. § 7506[c][1].)

State Regulations

Air quality is regulated at the state level by the California Air Resources Board (CARB), the agency designated to prepare the SIP required by the federal CAA, under the California Clean Air Act of 1988 (Assembly Bill [AB] 2595) and other provisions of the California Health and Safety Code (Health and Safety Code § 39000 *et seq.*). California's Clean Air Act (CCAA) requires all districts designated as nonattainment for any pollutant to "adopt and enforce rules and regulations to achieve and maintain the state and federal ambient air quality standards in all areas affected by emission sources under their jurisdiction."

The responsibility for controlling air pollution in California is shared by 35 local or regional air pollution control and air quality management districts, CARB, and EPA. The districts issue permits for industrial pollutant sources and adopt air quality management plans and rules. CARB establishes the state ambient air quality standards, adopts and enforces emission standards for mobile sources, adopts standards and suggested control measures for toxic air contaminants, provides technical support to the districts, oversees district compliance, approves local air quality plans, and prepares and submits the SIP to EPA. EPA establishes NAAQS, sets emission standards for certain mobile sources (airplanes and locomotives), oversees the state air programs, and reviews and approves the SIP. CARB inventories sources of air pollution in California's air basins and is required to update the inventory triennially, starting in 1998 (Health and Safety Code §§ 39607 and 30607.3). CARB also identifies air basins that are affected by transported air pollution (Health and Safety Code § 39610; 17 C.C.R. Part 70500).

National and State Ambient Air Quality Standards

As required by the CAA Amendments of 1970 (P.L. 91-064, December 31, 1970) and the CAA Amendment of 1977 (P.L. 95-95, August 7, 1977), EPA has established NAAQS for the following air pollutants: CO, O_3, NO_2, PM10, SO_x, and Pb. CARB has also established standards for these pollutants. Recent legislation requires CARB to develop and adopt regulations to reduce greenhouse gases (AB 1493, 2002). The federal and state governments have both adopted health-based standards for pollutants. For some pollutants, the national and state standards are very similar; for other pollutants, the state standards are more stringent. The differences in the standards are generally due to the different health effect studies considered during the standard-setting process and how these studies were interpreted.

Table 3.3-1 lists the federal and state standards. The federal primary standards are intended to protect the public health with an adequate margin of safety. The federal secondary standards are intended to protect the nation's welfare and account for air-pollutant impacts on soil, water, visibility, vegetation, and other aspects of the general welfare. Areas that violate these standards are designated nonattainment areas. Areas that once violated the standards but now meet the standards are classified as maintenance areas. Classification of each area under the federal standards is done by EPA based on state recommendations and after an extensive review of monitored data. Classification under the state standards is done by CARB.

Table 3.3-1
State and National Ambient Air Quality Standards

Pollutant	Averaging Time	California Standards[a]		Federal Standards[b]		
		Concentration[c]	Method[d]	Primary[c,e]	Secondary[c,f,g]	Method[g]
O_3	1 hour	0.09 ppm (180 µg/m^3)	Ultraviolet photometry	0.12 ppm (235 µg/m^3)[h]	Same as primary standard	Ultraviolet photometry
	8 hour	N/A		0.08 ppm (157 µg/m^3)[h]		
PM10	24 hour	50 µg/m^3	Gravimetric or beta attenuation	150 µg/m^3	Same as primary standard	Inertial separation and gravimetric analysis
	Annual arithmetic mean	20 µg/m^3		50 µg/m^3		
PM2.5	24 hour	No separate state standard	Gravimetric or beta attenuation	65 µg/m^3	Same as primary standard	Inertial separation and gravimetric analysis
	Annual arithmetic mean	12 µg/m^3		15 µg/m^3		
CO	8 hour	9.0 ppm (10 mg/m^3)	NDIR	9 ppm (10 mg/m^3)	None	NDIR
	1 hour	20 ppm (23 mg/m^3)		35 ppm (40 mg/m^3)		
	8 hour (Lake Tahoe)	6 ppm (7 mg/m^3)		N/A		
NO_2	Annual arithmetic mean	N/A	Gas phase chemilum-incescence	0.053 ppm (100 µg/m^3)	Same as primary standard	Gas phase chemilum-incescence
	1 hour	0.25 ppm (470 µg/m^3)		N/A		
Pb[i]	30 days average	1.5 µg/m^3	Atomic absorption	N/A	N/A	High volume sampler and atomic absorption
	Calendar quarter	N/A		1.5 µg/m^3	Same as primary standard	
SO_2	Annual arithmetic mean	N/A	Ultraviolet Fluorescence	0.030 ppm (80 µg/m^3)	N/A	Spectro-photometry (Pararosoani-line method)
	24 hour	0.04 ppm (105 µg/m^3)		0.14 ppm (365 µg/m^3)	N/A	
	3 hour	N/A		N/A	0.5 ppm (1300 µg/m^3)	
	1 hour	0.25 ppm (655 µg/m^3)		N/A	N/A	
Visibility reducing particles	8 hour (10 a.m. to 6 p.m., Pacific Standard Time)	In sufficient amount to produce an extinction coefficient of 0.23 per km-visibility of 10 mi (16 km) or more (0.07–30 mi [.011–48 km] or more for Lake Tahoe) due to particles when the relative humidity is less than 70%. Method: Beta attenuation and transmittance through filter tape.		No federal standards		

Pollutant	Averaging Time	California Standards[a]		Federal Standards[b]		
		Concentration[c]	Method[d]	Primary[c,e]	Secondary[c,f,g]	Method[g]
Sulfates	24 hour	25 µg/m^3				
Hydrogen sulfide	1 hour	0.03 ppm (42 µg/m^3)	Ultraviolet fluorescence			
Vinyl Chloride[h]	24 hour	0.01 ppm (26 µg/m^3)	Gas chroma-tography			

µg/m^3 = micrograms per cubic meter.
mg/m^3 = milligrams per cubic meter.
N/A = not available.
NDIR = Non-dispersive infrared photometry.
ppm = parts per million.

[a] California standards for O_3, CO (except Lake Tahoe), SO_2 (1 and 24 hour), NO_2, suspended particulate matter-PM10, PM2.5, and visibility reducing particles, are values that are not to be exceeded. All others are not to be equaled or exceeded. California ambient air quality standards are listed in the Table of Standards in Section 70200 of Title 17 C.C.R.

[b] National standards (other than O_3, particulate matter, and those based on annual averages or annual arithmetic mean) are not to be exceeded more than once a year. The ozone standard is attained when the fourth highest 8-hour concentration in a year, averaged over 3 years, is equal to or less than the standard. For PM10, the 24-hour standard is attained when the expected number of days per calendar year with a 24-hour average concentration above 150 µg/m3 is equal to or less than one. For PM2.5, the 24-hour standard is attained when 98% of the daily concentrations, averaged over 3 years, are equal to or less than the standards.

[c] Concentration expressed first in units in which it was promulgated. Equivalent units given in parentheses are based upon a reference temperature of 25 °C (77 °F) and a reference pressure of 760 mm (30 in) of mercury. Most measurements of air quality are to be corrected to a reference temperature of 25 °C (77 °F) and reference pressure measurements of air quality are to be corrected to a reference temperature of 25 °C (77 °F) and a reference pressure of 760 mm (30 in) of mercury (1,013.2 millibar [1 atmosphere]); ppm in this table refers to ppm volume, or micromoles of pollutant per mole of gas.

[d] Any equivalent procedure that can be shown to the satisfaction of CARB to give equivalent results at or near the level of the air quality standard may be used.

[e] National Primary Standards: The levels of air quality necessary, with an adequate margin of safety to protect the public health.

National Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant.

[f] Reference method as described by EPA. An "equivalent method" of measurement may be used but must have a "consistent relationship to the reference method" and must be approved by EPA.

[g] New federal 8-hour O_3 and PM2.5 standards were promulgated by EPA on July 18, 1997.

[h] ARB has identified lead and vinyl chloride as "toxic air contaminants" with no threshold level of exposure for adverse health effects determined. These actions allow for the implementation of control measures at levels below the ambient concentrations specified for these pollutants.

Source: California Air Resources Board 2003.

B. METHOD OF EVALUATION OF IMPACTS

Pollutants

Pollutants that can be traced principally to transportation sources and are thus relevant to the evaluation of the project alternatives include CO, O_3 precursors (NO_x and ROG), PM10, and CO_2. Since high CO levels are mostly the result of congested traffic conditions combined with adverse meteorological conditions, high CO concentrations are generally occur within 300 ft (91 m) to 600 ft (183 m) of heavily traveled roadways. Concentrations of CO on a regional and localized or microscale basis can consequently be predicted appropriately. As discussed above in the affected environment section, TOG and NO_x emissions from mobile sources are of concern primarily because of their role as precursors in the formation of O_3 and particulate matter. O_3 is formed through a series of reactions that occur in the atmosphere in the presence of sunlight over a period of hours. Since the reactions are slow and occur as the pollutants are diffusing downwind, elevated O_3 levels are often found many miles from sources of the precursor pollutants. The

impacts of TOG and NO_x emissions are therefore generally examined on a regional level. CO_2 emission burdens, because of their global impact, are currently expressed only on the statewide level by CARB and EPA. In this analysis, therefore, CO_2 impacts are discussed on the statewide level. It is appropriate to predict concentrations of PM10 on a regional and localized basis. EPA is currently developing a standardized methodology to evaluate PM10 on a local level.

Pollutant Burdens

The air quality analysis for this Program EIR/EIS focuses on the potential statewide, regional, and localized impacts on air quality. The regional pollutant burdens were estimated based on changes that would occur, including the following, under each of the alternatives.

- Highway vehicle miles traveled (VMT).
- Number of plane operations.
- Number of train movements (proposed HST and existing LOSSAN system).
- Power requirements for the proposed HST system.

Localized air quality impacts were estimated near proposed station locations and airports potentially affected by the Modal and HST Alternatives. The potential impacts of these alternatives were compared to existing conditions and the No Project Alternative.

A comparison of the 2002 conditions to the 2020 No Project conditions illustrates the expected trends in air quality. The potential impacts from proposed alternatives were then added to the 2020 conditions. Changes in VMT for on-road mobile sources (vehicles) and for off-road mobile sources (number of plane operations and train movements) were estimated for each of the alternatives. Changes in emissions of stationary sources (electrical power generators) were also assessed.

Highway VMT: On-road pollutant burdens were calculated as a ratio of baseline VMT to estimated VMT changes under each alternative. Although vehicular speeds affect emission rates, the potential basin-wide speed changes were considered too small to affect overall emission estimates; thus changes in future on-road mobile source emission burdens for the project were based solely on VMT changes and did not consider speed.

Number of Plane Operations: The Federal Aviation Administration's (FAA's) Emission and Dispersion Modeling System (EDMS) is used to estimate airplane emissions. The EDMS model estimates the emissions generated from a specified number of landing and take-off (LTO) cycles. Along with the emissions from the planes themselves, emissions generated from associated ground maintenance requirements are also included. Average plane emissions are calculated based on a typical 737 aircraft. The pollutant burdens generated by the LTOs under each alternative were added to CARB's off-road mobile sources (planes) emission budgets for each air basin to determine the potential impacts of the alternatives.

Number of Train Movements: 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 ridership beyond 2020 (Charles River Associates 1996). The figures on the lower end of these estimates are considered *investment-grade forecasts,* which were used in the California High Speed Rail Authority's (Authority's) final business plan (Business Plan) and are based conservatively on current 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 intercity HST system. The sensitivity analysis

started with the investment-grade ridership forecasts and applied variations in mode characteristics that tend to increase HST ridership and revenue to determine how sensitive HST ridership is to travel times, fares, etc. This sensitivity analysis produced a higher ridership forecast, which is used in this Program EIR/EIS to define a maximum impact potential of the Modal and HST Alternatives.

For this report and the overall Program EIR/EIS process, 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 scenario to represent total capacity, 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 air quality analysis, the high-end forecasts result in a benefit because of additional VMT being removed from the road and a decrease in LTO cycles for planes. In those cases, additional analysis is included in this Program EIS/EIR also to address the impacts associated with the low-end (investment-grade) forecasts.

To determine the number of plane trips potentially replaced from the No Project scenario daily by the HST Alternative, the following calculations were performed using sensitivity ridership variation projections as defined above. The number of annual air trips that could be removed by the proposed HST system (25.3 million) was divided by an average number of passengers per flight (101.25). The resulting number of flights per year (250,551) was then divided by the number of days per year to reach the number of flights per day (771) that could potentially be removed by the proposed HST system. (See Chapter 2 *Alternatives*, for definition of system alternatives.)

25.3 million trips = 25.3 million flying passengers (1 trip = 1 takeoff and 1 landing)

1 flight = 101.25 passengers (135 seats X 75% load factor, as per Table 3.2-3 in the *System Definition Report*)

Therefore,

250,551 flights/year = (25,368,285 passengers/year) / (101.25 passengers/flight)

771 flights/day = 250,551 flights/year X 1 year / 325 days

Similar calculations were prepared for the proposed HST Alternative based on the investment-grade ridership forecasts.

Additional train emissions from potentially increased feeder service to the proposed HST service were also assessed based on predicted ridership forecasts.

<u>Power Requirements</u>: In addition to the on-road and off-road emission burdens, emissions resulting from the power generated to run the HST system were estimated and included in the emission burden of the HST Alternative. Emission estimates are based on British thermal unit (BTU) requirements calculated in the energy analysis for the project (see Section 3.5). BTU emission factors are based on information from *Conserving Energy and Preserving the Environment: The Role of Public Transportation* (Shapiro et al. 2002), and the *Transportation Energy Data Book* (U.S. Department of Energy 2002).

Pollutant burdens generated by on-road (vehicles), off-road (planes, trains), and stationary (electric power generation) sources were combined and compared to the No Project Alternative and to each other, i.e. among the Modal and HST Alternatives. Because of the nature of

electrical power generation and the use of a grid system to distribute electrical power, it is not yet clear which facilities would be supplying power to the proposed HST system. Emission changes from power generation can therefore be predicted on a statewide level only.

C. RATING SCHEME

The relevance of the potential emission changes was assessed from a total pollutant burden and percentage change compared to the No Project Alternative in the affected air basins and statewide. Depending on each air basin's attainment status (see Table 3.3-3), the predicted differences were ranked as a high (+ or -), medium (+ or -), or low (+ or -) impact. The ranking of high, medium, or low is based on the potential magnitude of the emission changes compared to U.S. EPA's General Conformity threshold levels for nonattainment and maintenance areas and the No Project emission inventory (for on-road sources, planes, and trains) for each air basin.

This assessment is based on the total pollutant burden of an area under the No Project Alternative and the change in emissions estimated under a proposed alternative. Both positive and negative impacts were considered. A positive (+) impact indicates a potential benefit (i.e., a decrease in emissions) to an air basin for a specific pollutant; a negative (-) impact indicates a potential detriment (i.e., an increase in emissions) to an air basin.

The following factors were used to rate the potential affects of each proposed project alternative:

- The threshold values provided in EPA's Conformity Rule (see Table 3.3-2) that determine when a detailed conformity analysis is required for a proposed federal project located in a nonattainment or maintenance area;
- The conformity rule's definition (40 C.F.R. P 55.852) of a regionally significant project, which is one that would increase emissions of an applicable pollutant in a nonattainment or maintenance area by 10 percent or more; and
- CARB's emission inventories, which are the estimated amounts of pollutants emitted into the atmosphere in 2020 in each air basin from major stationary, area-wide, and natural source categories.

For the purpose of this analysis, a project alternative is considered to cause a low impact for a pollutant when it is estimated to increase or decrease the emissions of that pollutant in an air basin by an amount less than the appropriate conformity threshold value. A project alternative is considered to cause a medium impact when it is estimated to increase or decrease emissions by an amount greater than the conformity threshold value but less than 10 percent of the total emissions generated in the basin. A project alternative is considered to cause a high impact when it is estimated to increase or decrease emissions by an amount greater than 10 percent of the total emissions generated in the basin.

Changes in the amounts of carbon dioxide (which is a major component of greenhouse gases) as a result of the project alternatives were estimated on a statewide basis. These results are provided to indicate how changes in CO2 emissions, as a result of the HSR alternatives, might affect global warming. These estimates were based on the estimated changes in fuel use and electrical energy production associated with each alternative.

Table 3.3-2
General Conformity's Significant Impact Thresholds

Pollutant	Area's Attainment Status	Impact Thresholds (Tons (Metric Tons)/Year)
O_3 (VOCs or NO_x)	Nonattainment—serious	50 (45)
	Nonattainment—severe	25 (23)
	Nonattainment—extreme	20 (18)
	Nonattainment—outside an ozone transport region	100 (91)
	Nonattainment—moderate/marginal inside an ozone transport region	50/100 (45/91) (VOC/NO_x)
	NO_x maintenance	100 (91)
	VOC maintenance—outside ozone transport region	100 (91)
	VOC maintenance—inside ozone transport region	50 (45)
CO	Nonattainment—all	100 (91)
	Maintenance	100 (91)
PM10	Nonattainment—moderate	100 (91)
	Nonattainment—serious	70 (64)
	Maintenance	100 (91)

VOC = volatile organic compound.

Source: Code of Federal Regulations, Title 40, Part 51, Subpart W.

D. LOCALIZED AIR QUALITY IMPACTS

To quantify a project's impact on local pollutant levels, a screening analysis was conducted based on overall traffic volumes and projected changes in volume-to-capacity (V/C) ratios and level of service estimates. Per state and national guidelines (California Department of Transportation 1997), baseline intersection level of service estimates of D or below that would degrade because of a project have the potential to affect local air quality. Similarly, volume increases of greater than 5% could potentially impact local air quality levels. The traffic analyses determined which roadways would experience an impact (positive or negative) under the project alternatives.

For this level of analysis, however, detailed intersection information has not been generated. Rather, traffic screenlines have been developed. *Screenlines* describe defined segments of a roadway that were selected to reasonably represent the routes affected by the proposed alternatives, as discussed in detail in Section 3.1, *Traffic and Circulation*. The estimated traffic volume generated or reduced by the Modal and HST Alternatives was added to No Project traffic volumes and expressed as overall screenline volumes (typical values based on averages over time), level of service, and V/C ratios. These factors were compared to No Project values, and locations with potentially high impacts were identified. The screenlines do not include an analysis of intersections and are therefore not detailed enough to be used for an air quality intersection screening analysis. However, the screenline numbers provide a general idea of the project's impact on the roadway network. Based on these numbers, general potential impacts on the local roadway network for each of the alternatives are discussed below.

3.3.2 Affected Environment

A. STUDY AREAS DEFINED

California is divided into 15 air basins (17 C.C.R. § 60100 *et seq.*). Each has unique terrain, meteorology, and emission sources. This analysis has been structured to estimate the potential impacts on the six air basins directly affected by the proposed alternatives, as illustrated in Figure 3.3-1. The following basins are considered in this study.

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

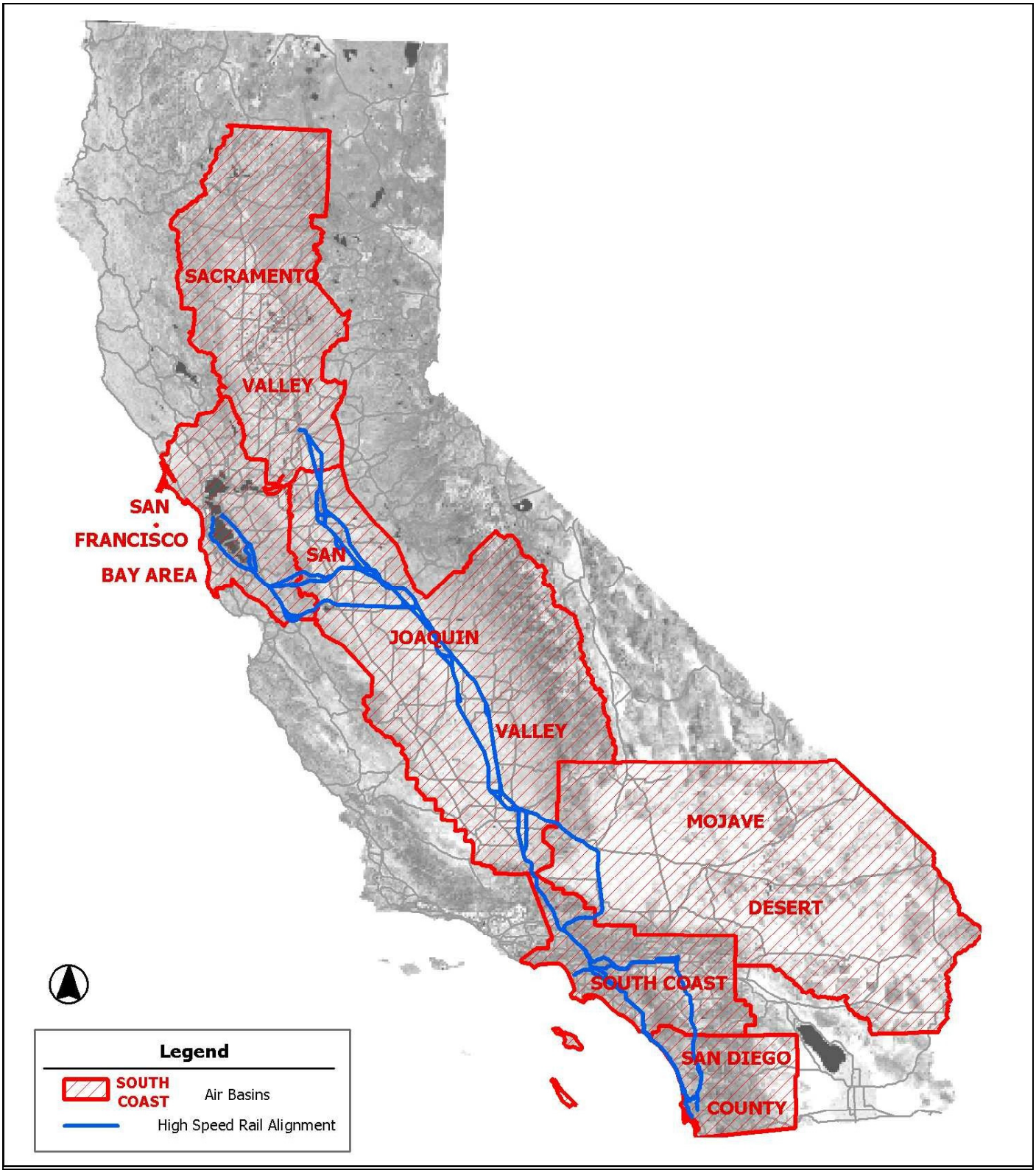
Air quality in nearby air basins could also be affected by changes in travel patterns, miles traveled, and regional pollutant transport resulting from the proposed alternatives. These effects are expected to be less than those experienced by the basins that physically contain the project. For this program-level analysis, potential impacts on air quality are described only for the air basins that physically contain the proposed alternatives. Nearby air basins are not discussed in this program-level analysis. Once the alternatives are refined and more detailed analyses are conducted, nearby basins should be studied.

B. GENERAL DISCUSSION OF AIR QUALITY RESOURCES

Each pollutant is briefly described below.

- Carbon monoxide (CO) is a colorless, odorless gas that is generated in the urban environment primarily by the incomplete combustion of fossil fuels in motor vehicles. Relatively high concentrations of CO can be found near crowded intersections and along heavily used roadways carrying slow-moving traffic. CO chemically combines with the hemoglobin in red blood cells to decrease the oxygen-carrying capacity of the blood. Prolonged exposure can cause headaches, drowsiness, or loss of equilibrium.
- Sulfur oxides (SO_x) constitute a class of compounds of which sulfur dioxide (SO_2) and sulfur trioxide (SO_3) are of great importance in air quality. SO_x is also generated by the incomplete combustion of fossil fuels in motor vehicles. However, relatively little SO_x is emitted from motor vehicles. The health effects of SO_x include respiratory illness, damage to the respiratory tract, and bronchio-constriction.
- Hydrocarbons (HC) comprise a wide variety of organic compounds, including methane (CH_4), emitted principally from the storage, handling, and combustion of fossil fuels. Hydrocarbons are classified according to their level of photochemical reactivity: relatively reactive or relatively non-reactive. Non-reactive hydrocarbons consist mostly of methane. Emissions of total organic gases (TOG) and reactive organic gases (ROG) are two classes of hydrocarbons measured for California's emission inventory. TOG includes all hydrocarbons, both reactive and non-reactive. In contrast, ROG includes only the reactive HC. TOG is measured because non-reactive HC have enough reactivity to play an important role in photochemistry. Though HC can cause eye irritation and breathing difficulty, their principal health effects are related to their role in the formation of ozone. HC is also considered a greenhouse gas.

Figure 3.3-1.
Air Basins Potentially Affected by Project Alternatives



- Nitrogen oxides (NO_x) constitute a class of compounds that include nitrogen dioxide (NO_2) and nitric oxide (NO), both of which are emitted by motor vehicles. Although NO_2 and NO can irritate the eyes and nose and impair the respiratory system, NO_x, like HC, is of concern primarily because of its role in the formation of ozone. Nitrogen oxide is also considered a greenhouse gas.
- Ozone (O_3) is a photochemical oxidant that is a major cause of lung and eye irritation in urban environments. It is formed through a series of reactions involving HC and NO_x that take place in the atmosphere in the presence of sunlight. Relatively high concentrations of O_3 are normally found only in the summer because low wind speeds or stagnant air coupled with warm temperatures and cloudless skies provide the optimum conditions for O_3 formation. Because of the long reaction time involved, peak ozone concentrations often occur far downwind of the precursor emissions. Thus, ozone is considered a regional pollutant rather than a localized pollutant.
- Particulate matter includes both airborne and deposited particles of a wide range of size and composition. Of particular concern for air quality are particles smaller than or equal to 10 microns and 2.5 microns in size, PM10 and PM2.5, respectively. The data collected through many nationwide studies indicate that most PM10 is the product of fugitive dust, wind erosion, and agricultural and forestry sources, while a small portion is produced by fuel combustion processes. However, combustion of fossil fuels account for a significant portion of PM2.5. Airborne particulate matter mainly affects the respiratory system.
- Lead (Pb) is a stable chemical element that persists and accumulates both in the environment and in humans and animals. There are many sources of lead pollution, including mobile sources such as motor vehicles and other gasoline-powered engines, and non-mobile sources such as petroleum refineries. Lead levels in the urban environment from mobile sources have significantly decreased due to the federally mandated switch to lead-free gasoline. The principal effects of lead on humans are on the blood-forming, nervous, and renal systems.
- Carbon dioxide (CO_2) is a colorless, odorless gas that occurs naturally in the earth's atmosphere. Significant quantities are also emitted into the air by fossil fuel combustion. CO_2 is considered a greenhouse gas. The natural *greenhouse effect* allows the earth to remain warm and sustain life. Greenhouse gases trap the sun's heat in the atmosphere and help determine our climate. As atmospheric concentrations of greenhouse gases rise, so may temperatures. Higher temperatures may result in more emissions, increased smog, and respiratory disease.

The existing (Year 2001) baseline pollutant burden for each of the six air basins is described in the following section. The existing baseline represents the current air quality conditions in each of the air basins in the study area. The future No Project conditions are considered the estimated 2020 future baseline pollutant burden for each of the affected air basins. The existing and future baseline information was developed using the CARB pollutant burden projections for the years 2001 and 2020 available at the CARB Web site, with the year 2020 corresponding to the comparison year for the system alternatives. CARB projections are based on future growth levels in stationary, area-wide, and mobile sources. CARB projections account for emission reductions resulting from clean vehicles and clean fuel programs. There are two categories of mobile sources: on road and off road. Vehicles licensed for highway use are considered on-road mobile sources; airplanes, marine vessels, locomotives, construction and garden equipment, and recreational off-road vehicles are considered off-road mobile sources.

C. AIR RESOURCES BY AIR BASIN

The air quality attainment status based on state and federal standards for CO, particulate matter, and O_3 for each of the air basins in the study area is shown in Table 3.3-3. All air basins are assigned an *attainment status* for air pollutants based on meeting state and federal pollutant standards. There

are some differences between state and federal standards, so a pollutant might not have the same status under each standard. A basin is considered in *attainment* for a particular pollutant if it meets the standards set for that pollutant. A basin is considered in *maintenance* for a pollutant if the standards were once violated but are now met. And a basin is considered *nonattainment* for a particular pollutant if its air quality exceeds standards for that pollutant. A basin is considered unclassified if the area cannot be classified on the basis of available information as meeting or not meeting the applicable standard. The standards and status designations are discussed in more detail above in Section 3.3.1, *Regulatory Requirements and Methods of Evaluation*.

Table 3.3-3
Attainment Status of Affected Air Basins

	COCO		PM2.5	PM10		O_3	
Air Basin	**National Standard**	**State Standard National Standard**	**National State Standard**	**National Standard**	**State Standard**	**National Standard**	**State Standard**
Sacramento Valley	Maintenance	Unclassified/ Attainment Maintenance	Attainment Unclassified/ attainment	Portions Unclassified/ Portions Moderate nonattainment	Nonattainment	Portions Unclassified-Attainment/ Portions Serious/ Nonattainment	Nonattainment /Portions Nonattainment -Transitional
San Francisco Bay Area	Maintenance	Attainment Maintenance	Attainment	Unclassified	Nonattainment	Marginal Nonattainment	Nonattainment
San Joaquin Valley	Maintenance	Unclassified/ Attainment Maintenance	Nonattainment Unclassified/ attainment	Serious Nonattainment	Nonattainment	Serious Nonattainment	Nonattainment
Mojave Desert	Unclassified/ Attainment	Unclassified/ Attainment Unclassified/ attainment	Attainment Unclassified/ attainment	Moderate Nonattainment	Nonattainment	Portions Unclassified-Attainment/ Portions Moderate Nonattainment	Nonattainment
South Coast	Serious Nonattainment	Nonattainment /Transitional Nonattainment	Nonattainment Non-attainment/ transitional	Serious Nonattainment	Nonattainment	Severe Nonattainment	Nonattainment
San Diego County	Maintenance	Attainment Maintenance	NonAttainment	Unclassified	Nonattainment	Nonattainment	Nonattainment

Source: California Air Resources Board 2002.

San Francisco Bay Area Air Basin

The San Francisco Bay Area Air Basin covers California's second largest metropolitan area. The counties in the air basin include Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, and Santa Clara, as well as the southern half of Sonoma County and the southwestern portion of Solano County. The unifying feature of the basin is the San Francisco Bay, which is oriented north-south and covers about 400 square miles (sq mi) (1,036 square kilometers [sq km]) of the area's total 5,545 sq mi (14,361 sq km). Approximately 20% of California's population resides in this air basin. The area is surrounded by hills, but low passes and the Sacramento–San Joaquin River Delta, which extends to the San Francisco Bay, allow some air pollutant transport to the Central Valley.

Pollution sources in the basin account for about 16% of the total statewide criteria pollutant emissions. The basin is classified as follows: maintenance for CO, attainment for PM2.5, unclassified for PM10, and marginal nonattainment for ozone.

Emissions of O_3 precursors (NO_x and TOG) have decreased since 1975 and are projected to continue declining through 2010. This is the result of strict motor vehicle controls that have reduced emissions from mobile sources of these pollutants. Stationary source emissions of TOG have declined over the last 20 years because of new controls on oil refinery fugitive emissions and new rules for control of TOG from various industrial coatings and solvent operations.

PM10 emissions are predicted to increase through 2010. This increase is due to growth in emissions from area-wide sources, primarily fugitive dust sources. Mobile source emissions from diesel motor vehicles have been decreasing since 1990 even though population and VMT have been growing. This is due to stringent emission standards.

CO emissions have been declining in the basin over the last 25 years, and this trend is expected to continue. Motor vehicles and other mobile sources are the largest sources of CO emissions in the air basin. Due to stringent controls measures, CO emissions from motor vehicles have been declining.

Sacramento Valley Air Basin

The Sacramento Valley Air Basin encompasses the northern portion of the Central Valley. The air basin includes the counties of Butte, Colusa, Glenn, Sacramento, Shasta, Sutter, Tehama, Yolo, and Yuba, along with the western urbanized portion of Placer County and the eastern portion of Solano County. The basin covers more than 15,000 sq mi (38,850 sq km) and accounts for approximately 6% of the state's population. It is the fifth-most-populated air basin in California.

Portions of the basin are classified as follows: maintenance for CO, attainment for PM2.5, unclassified and moderate attainment for PM10, and unclassified/attainment and serious nonattainment for ozone.

Population in the air basin grew between 1981 and 2000 by 51%, a rate higher than the 39% increase statewide. VMT increased by 95%, slightly higher than the 91% increase statewide. However, emissions of the O_3 precursors, NO_x and TOG, have decreased since 1990 and are projected to continue declining through 2010 because of more stringent mobile source emission standards and cleaner-burning fuels. TOG levels have also declined because of new rules controlling various industrial coating and solvent operations.

While emission levels of O_3 precursors are decreasing, peak O_3 values in the Sacramento Valley Air Basin have not declined as quickly as in other urban areas. Additional emission controls will be needed to bring the area into attainment for the state and national ozone standards.

Direct emissions of PM10 are increasing in the basin. This increase is due to growth in emissions from area-wide sources, primarily fugitive dust from paved and unpaved roads, construction and demolition, and residential fuel combustion. These area-wide emission sources have increased because of population growth and increased VMT.

CO emissions are declining in the basin. With new stringent emission standards, CO emissions from motor vehicles have declined. Stationary and area-wide source CO emissions have remained relatively steady, with additional emission controls offsetting growth. These controls will help keep the area in attainment for both the state and national CO standards.

San Joaquin Valley Air Basin

The San Joaquin Valley Air Basin encompasses the southern two-thirds of California's Central Valley. The counties in this basin include Fresno, Kings, Madera, Merced, San Joaquin, Stanislaus, Tulare, and the western portion of Kern. The basin spreads across 25,000 sq mi (64,750 sq km). The basin is mostly flat and unbroken with most of the area below 400 ft (122 m) elevation. The San Joaquin River runs along the western side of the basin from south to north. The San Joaquin Valley has cool wet winters and hot dry summers. Generally the temperature increases and rainfall decreases from north to south.

Air quality is not dominated by emissions from one large urban area in this basin. Instead, there are a number of moderately sized urban areas spread along the main axis of the valley. Approximately 9% of the state's population lives in the San Joaquin Valley. Pollution sources in the region account for about 14% of the total statewide criteria pollutant emissions.

The basin is classified as follows: maintenance for CO, nonattainment for PM2.5, serious nonattainment for PM10, and serious nonattainment for ozone.

The population in the San Joaquin Valley Air Basin increased by 56% from 1981 to 2000. This is a much higher rate than the statewide average of 39%. During the same time period, the daily VMT increased by 136%, again much higher than the overall statewide average of 91%. Overall, except for PM10, the emission levels in the San Joaquin Valley Air Basin have been decreasing since 1990. The rate of improvement, however, has not been the same as for other air basins. This is due mainly to the large growth rates this area has experienced.

Emissions of the O_3 precursors, NO_x and TOG, are decreasing in the air basin. NO_x emissions have decreased by approximately 24% since 1985, and are predicted to decrease another 26% by 2010. ROG emissions have decreased by approximately 48% since 1985. They are predicted to decrease another 11% by 2010. These reductions have resulted from more stringent mobile and stationary source emission controls and standards. The basin has shown less improvement than other areas due in large part to the growth rates in population and VMT.

Direct emissions of PM10 have been increasing in the air basin and are expected to continue increasing. This increase is due to growth in emissions from area-wide sources, primarily fugitive dust from vehicle travel on unpaved and paved roads, waste burning, and residential fuel combustion. These increases are a direct result of the large growth in population and VMT. Mobile sources (emissions directly emitted from motor vehicles) are predicted to decrease through 2010 because of new diesel standards.

CO emissions have been trending downward since 1985 and are expect to continue downward through 2010. Motor vehicles are the largest source of CO emissions in the air basin. Emissions from motor vehicles have been declining since 1985, despite increased VMT. This is due to stringent emission control measures and standards.

Mojave Desert Air Basin

The Mojave Desert Air Basin is located in the southeastern section of California. It is bordered on the south by the Salton Sea Air Basin, on the west by the South Coast and the San Joaquin Valley Air Basins, on the north by the Great Basin Valleys Air Basin, and on the east by the states of Nevada and Arizona. It encompasses the high desert region of San Bernardino County and the desert portions of Kern and Los Angeles Counties. With an area in excess of 25,950 sq mi (67,210 sq km), it is the second largest of California's air basins and accommodates approximately 2.5% of the state population. Air quality is dominated by emissions from urban areas in the western portions of the basin and from transported emissions from the large urban areas to the south and west.

Communities such as Hesperia and Phelan, which are in close proximity to the Cajon Pass, historically experience the highest O_3 levels in the basin. This is due to pollutants funneled into the high desert through the pass from Los Angeles and the San Bernardino Valley. These pollutants are dispersed as they are blown inland. Locally generated O_3 precursor emissions of NO_x and ROG also contribute to the high O_3 levels that affect the basin. Emission controls, mainly for exhaust emissions, have resulted in reductions in NO_x, ROG, and CO levels. Emissions of the O_3 precursors NO_x and ROG have been trending downward since 1990, as have been CO emissions. PM10 emissions in the basin, however, continue to rise as the volume of vehicles on unpaved roads and off road increases.

Portions of the basin are classified as follows: unclassified/attainment for CO, attainment for PM2.5, moderate attainment for PM10, and unclassified/attainment and moderate nonattainment for ozone.

South Coast Air Basin

The South Coast Air Basin encompasses 6,729 sq mi (17,428 sq km). It includes California's largest metropolitan region: all of Orange County, the western highly urbanized portions of San Bernardino and Riverside Counties, and the southern two-thirds of Los Angeles County. It accommodates a population of 14.9 million, or more than 40% of California's population, and is the most populous air basin in the state. About 30% of the state's total criteria pollutant emissions are generated in the basin. The basin is generally a lowland plain bounded by the Pacific Ocean on the west and by mountains on the other three sides.

The population in the South Coast Air Basin grew at high rates from 1981 to 2000, increasing 34% from 11.1 million in 1981 to 14.9 in 2000. Daily VMT increased about 84% during that same period. While high growth rates are generally associated with increased emissions, the implemented control programs in the basin have resulted in emission decreases.

The warm weather associated with predominantly high-pressure systems in the basin is conducive to the formation of O_3. The surrounding mountains help cause frequent low inversion heights and stagnant air conditions. These factors combine to trap pollutants in the air basin, and resulting concentrations are among the highest in the state. Aggressive emission controls have resulted in a downward trend in O_3 levels.

The basin is classified as follows: serious nonattainment for CO, nonattainment for PM2.5, serious nonattainment for PM10, and serious nonattainment for ozone.

NO_x emissions in the basin fell by about 38% from 1985 to 2000 and are forecasted to continue that trend to 2010. ROG emissions remained relatively flat from 1975 to 1985. Between 1985 and 2000 they decreased by approximately 60%. ROG emissions are predicted to decrease another 40% by 2010. Emissions of CO in the South Coast Air Basin have been trending downward since 1975, even though VMT has increased and industry activity has grown.

Direct emissions of PM10 have increased in the South Coast Air Basin since 1975. The increase is attributed to emissions from area-wide sources such as fugitive dust from paved and unpaved roads. Growth in activity of the area-wide sources reflects the increased population growth and VMT in the basin. PM10 continues to be a problem in the South Coast Air Basin, which is designated as nonattainment for both the state and national ambient air quality standards. More controls specific to PM10 will be needed to reach attainment.

San Diego Air Basin

The San Diego Air Basin is located in the southwestern corner of California and comprises all of San Diego County. It is bounded on the south by Mexico, on the west by the Pacific Ocean, on the north by Orange and Riverside Counties, and on the east by Imperial County. Its 4,260-sq-mi (11,033-sq-km) area accommodates a population of 2.9 million, or 8% of the state's population, and produces about 7% of the state's criteria pollutant emissions.

In the last 20 years, the San Diego Air Basin has experienced one of the highest population growth rates of the state's urban areas. Population grew from more than 1.9 million in 1981 to 2.9 million in 2000. VMT more than doubled during that same period from 35 million to approximately 74 million mi (56 million to 119 million km). Despite this growth trend, the overall air quality of the basin has improved, reflecting the benefits of cleaner technology.

Much of the San Diego Air Basin has a relatively mild climate due to its southern location and proximity to the ocean. The majority of the population is concentrated in the western portion of the basin, and the emissions are concentrated there. The basin is impacted by locally produced emissions as well as pollutants transported from other areas. O_3 and O_3 precursor emissions are transported from the South Coast Air Basin and Mexico. Implemented controls have resulted in a downward trend in O_3 levels and reductions in emissions from its precursors NO_x and TOG in the basin. However, O_3 levels continue to pose problems because exceedances of the state and national ambient air quality standards persist.

CO concentrations in the San Diego Air Basin decreased approximately 56% from 1981 to 2000. As a result, the national CO standards have not been exceeded since 1989, and the state standard has not been exceeded since 1990. The basin will likely maintain its attainment status for both national and state standards by continuing the enforcement of the stringent motor vehicle regulations currently in place.

Direct emissions of PM10 in the San Diego Air Basin increased 69% from 1975 to 2000, and the forecast is for a continued increase at a rate of approximately 7% to 2010. Growth in area-wide source emissions, mainly fugitive dust from vehicles on paved and unpaved roads, dust from construction and demolition operations, and particulates from residential fuel combustion are mainly responsible for this increase. The growth in these area-wide sources primarily derives from the increase in population and VMT in the basin.

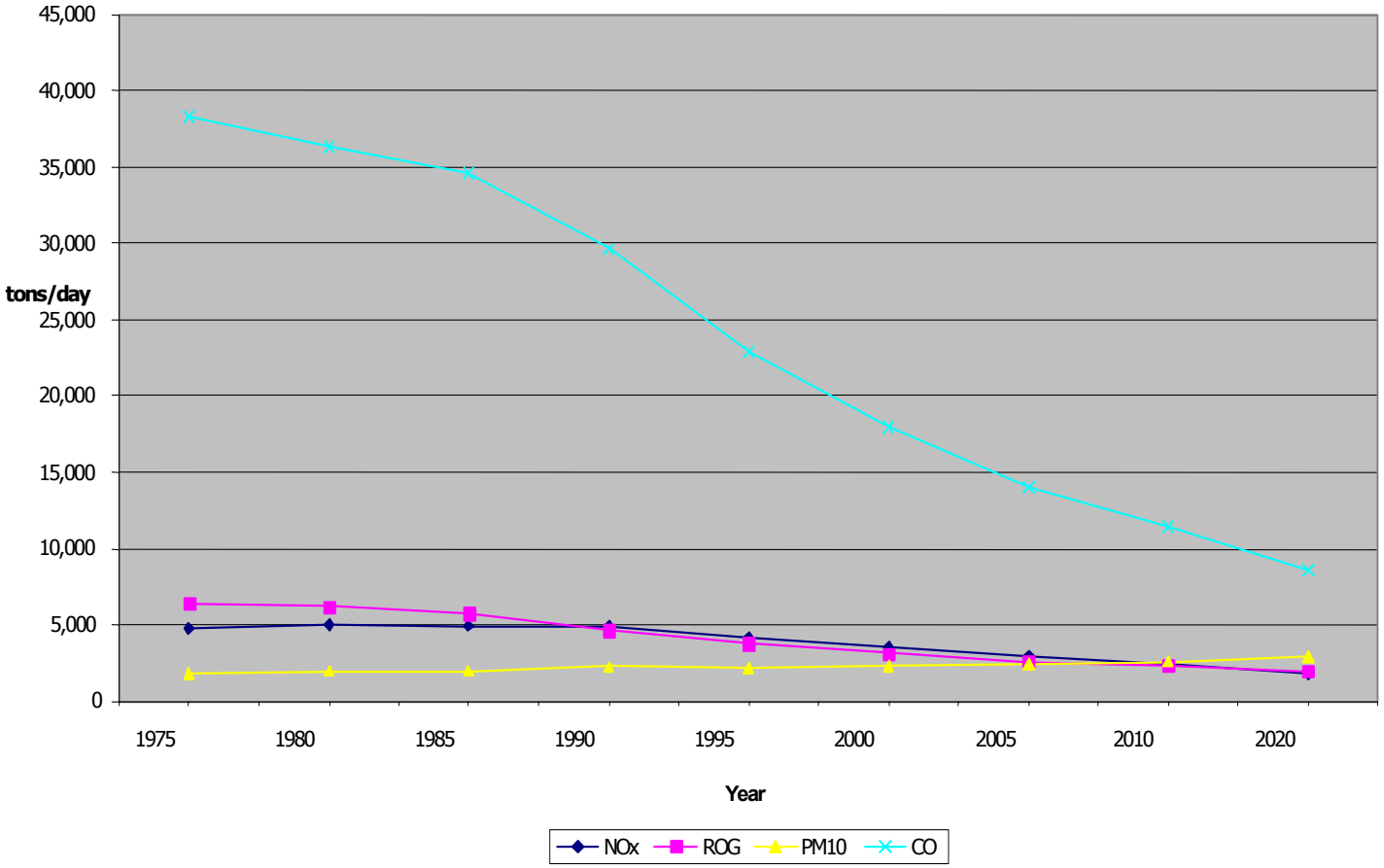
The basin is classified as follows: maintenance for CO, attainment for PM2.5, unclassified for PM10, and nonattainment for ozone.

3.3.3 Environmental Consequences

A. EXISTING CONDITIONS COMPARED TO NO PROJECT ALTERNATIVE

Pollutant burden levels of CO, NO_x, and TOG are predicted to decrease statewide through 2020 compared to 2002 levels (Figure 3.3-2). This decrease is due to the implementation of stringent standards, control measures, and state-of-the-art emission control technologies. Emissions per vehicle are dropping significantly in California as a result of CARB's clean vehicle and clean fuel programs. Consequently, motor vehicle emissions are declining overall despite an increase in VMT. The low emission vehicle (LEV) and LEVII regulations adopted in 1990 and 1998, respectively, require a declining average fleet emission rate for new cars, pickup trucks, and medium-duty vehicles (including sport utility vehicles). These regulations, which are being implemented between 1994 and 2010, are expected to result in about a 90% decline in new vehicle emissions. Similar emission reductions are occurring in the heavy-duty diesel truck fleet as progressively lower emission standards for new trucks are introduced. The next phase of tighter diesel truck standards, scheduled

Figure 3.3-2
Statewide Emissions (tons/day, annual average)



to be implemented between 2007 and 2010, is expected to produce an overall reduction of 98% from uncontrolled engine emissions.

According to CARB pollutant burden projections, emissions of PM10 are expected to increase statewide for the No Project Alternative compared to existing conditions. The upward trend in PM10 emissions is primarily due to increased emissions from area-wide sources, including dust from increased VMT on unpaved and paved roads. PM10 emissions from stationary sources are also expected to increase slightly in the future because of industrial growth.

CO_2 levels for 2002 are not currently available. In the November 2002 report "Inventory of California Greenhouse Gas Emissions and Sinks: 1990–1999," by the California Energy Commission, 1999 CO_2 emissions are estimated at 362.8 million metric tons. This estimate is not broken down by source type; therefore a direct comparison to No Project, which includes only on-road mobile, planes, trains, and electric power sources, cannot be made.

The percentage of each pollutant source that may be affected by the proposed alternatives is shown in Figure 3.3-3. Of the four sources of concern shown in the figure, on-road mobile is the largest single contributor for all the pollutants. For CO, on-road mobile sources would contribute 32% of the statewide total; for NO_x on-road mobile sources would contribute 24% of the statewide total. By detailing the potential overall contribution to statewide pollution levels of each of these sources, the relationship between changes in sources and overall pollution concentrations becomes clearer.

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

No Project Alternative Compared to Modal Alternative (Sensitivity Analysis Variations in Ridership Forecast)

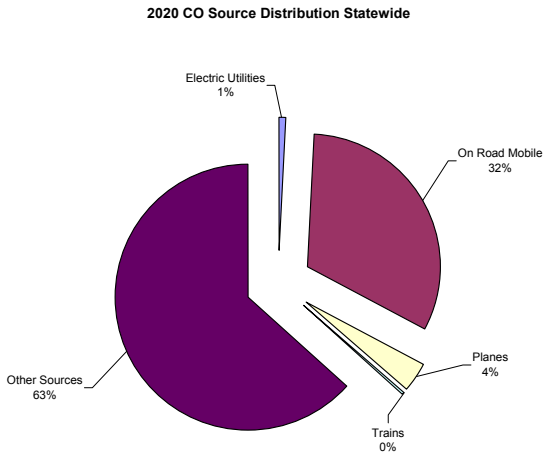
Roadways: The highway component of the Modal Alternative would add approximately 2,970 lane mi (4,780 km) to the highway system. According to the analysis in Chapter 5 addressing economic growth effects, the added lanes of the Modal Alternative would result in approximately 1.1% more VMT in 2020 than the No Project Alternative in 2020. Therefore, the Modal Alternative is predicted to increase the amount of on-road mobile source regional pollutants by 1.1% compared to No Project (Table 3.3-4).

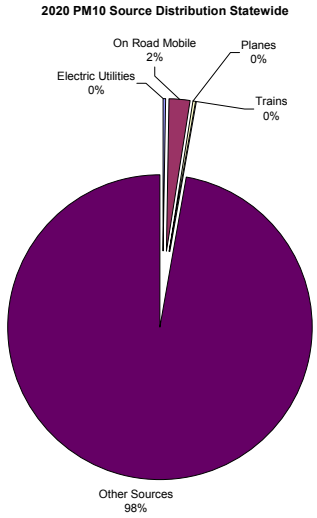
Air Travel: The same number of air trips would occur under both the No Project and Modal Alternatives. In the No Project Alternative these trips would be handled in an inefficient manner (i.e., more flights leaving at off-peak times). In the Modal Alternative these flights would be handled in a more efficient manner. Airport gates would need to be added, however, to efficiently handle the forecasted future demand (representative demand). The air travel component of the Modal Alternative is based on an estimated additional 91 airport gates required statewide to efficiently service the 34 million trips (68 million boarding/departing passengers) as defined for the Modal Alternative in Chapter 2. The additional gates would handle the trips projected for year 2020 more efficiently than No Project. Since additional gates would be built under the Modal Alternative to serve demand already projected under No Project, the Modal Alternative would generate no more LTOs than the No Project Alternative; therefore, no more airplane pollutant burdens would be generated as compared to the No Project Alternative. No Project and Modal Alternative plane emission burdens are shown in Table 3.3-5.

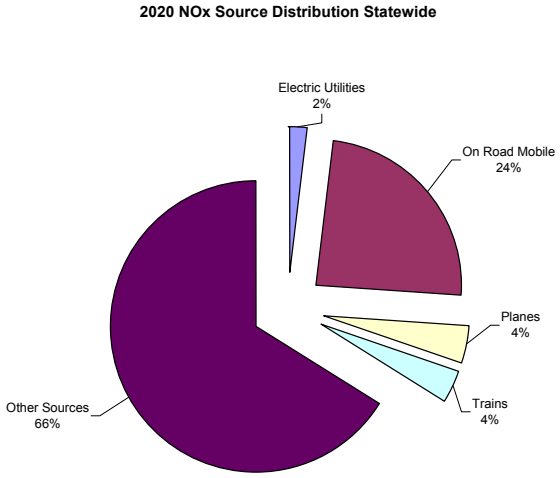
Train Travel and Electrical Power: Conventional rail service is not predicted to increase nor is additional electrical power predicted to be required under the Modal Alternative. Thus, the Modal Alternative would generate no more train or electrical power stationary pollutant burdens than No Project.

Figure 3.3-3

CO, PM_{10} NOX, TOG Source Distribution – Year 2020







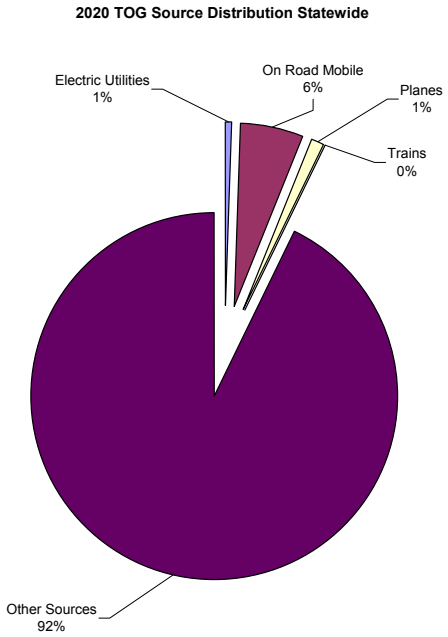


Table 3.3-4
On-Road Mobile Source Regional Analysis—No Project and Modal Alternatives

Air Basin	No Project VMT (Km) (2020) (in millions)	Modal VMT (Km) (2020) (in millions)	No Project Emission Burden in Tons (Metric Tons)/Day				Modal Alternative Emission Burden in Tons (Metric Tons)/Day				Incremental Change from No Project in Tons (Metric Tons)/Day and % Change from No Project			
			CO	PM10	NO_x	TOG	CO	PM10	NO_x	TOG	CO	PM10	NO_x	TOG
Sacramento Valley	84.079 (135.312)	85.004 (136.801)	187.28 (169.90)	3.79 (3.44)	35.85 (32.52)	26.12 (23.7)	189.34 (171.77)	3.83 (3.47)	36.24 (32.88)	26.41 (23.96)	2.06 (1.87) /1.1 %	0.04 (0.04) / 1.1%	0.39 (0.35) / 1.1%	0.28 (.25)/ 1.1 %
San Francisco Bay Area	213.901 (344.240)	216.253 (348.025)	522.13 (473.38)	10.71 (9.72)	101.30 (91.90)	66.81 (60.6)	527.87 (478.89)	10.83 (9.83)	102.41 (92.91)	67.54 (61.27)	5.74 (5.21)/ 1.1%	0.12 (0.11)/ 1.1%	1.11 (1.01)/ 1.1%	0.73 (0.66)/ 1.1%
San Joaquin	135.617 (218.254)	137.109 (220.656)	297.28 (269.69)	6.78 (6.15)	68.28 (61.94)	36.68 (33.3)	300.55 (272.66)	6.85 (6.21)	69.03 (62.62)	37.08 (33.64)	3.27 (2.97)/ 1.1%	0.07 (0.06)/ 1.1%	0.75 (0.68)/ 1.1%	0.4 (0.36)/ 1.1%
Mojave Desert	44.681 (71.907)	45.172 (72.697)	95.33 (86.48)	2.07 (1.88)	15.82 (14.35)	9.81 (8.9)	96.38 (87.44)	2.09 (1.90)	15.99 (14.51)	9.92 (8.99)	1.05 (0.95)/ 1.1%t	0.02 (0.02)/ 1.1%	0.17 (0.15)/ 1.1%	0.14 (0.13)/ 1.1%t
South Coast	402.116 (647.143)	406.539 (654.261)	944.92 (857.23)	19.57 (17.75)	180.01 (163.31)	121.67 (110.4)	955.31 (866.66)	19.79 (17.95)	181.99 (165.10)	123.01 (111.6)	10.39 (9.43)/ 1.1 %	0.22 (0.20)/ 1.1 %	1.98 (1.80)/ 1.1 %	1.34 (1.22)/ 1.1 %
San Diego County	97.542 (156.977)	98.614 (158.704)	224.86 (204.00)	4.77 (4.33)	41.48 (37.63)	28.45 (25.8)	227.33 (206.23)	4.82 (4.37)	41.94 (38.05)	28.76 (26.1)	2.47 (2.24)/ 1.1 %	0.05 (0.05)/ 1.1 %	0.46 (0.42)/ 1.1 %	0.31 (0.28)/ 1.1 %
Statewide (on-road mobile only)	1,109.510 (1,785.583)	1,099.637 (1,769.694)	2649.61 (2403.7)	53.58 (48.61)	515.11 (467.31)	341.44 (309.8)	2674.6 (2426.4)	54.1 (49.08)	519.98 (471.73)	344.62 (312.6)	24.99 (22.67) / 0.9 %	0.52 (0.47)/ 0.9 %	4.87 (4.42)/ 0.9 %	5.19 (4.7)/ 0.9 %

Table 3.3-5
Airplane Pollutant Burdens—No Project and Modal Alternatives

	2020 Planes No Project Alternative in Tons (Metric Tons)/Day				2020 Burden per Flight in Tons (Metric Tons)/Day*				Number of Additional Planes for Modal Alternative	2020 Additional Burden Modal Alternative in Tons (Metric Tons)/Day				2020 Total Plane Burden Modal Alternative in Tons (Metric Tons)/Day			
Air Basin	CO	PM10	NO_x	TOG	CO	PM10	NO_x	TOG		CO	PM10	NO_x	TOG	CO	PM10	NO_x	TOG
Sacramento Valley	19.35 (17.55)	0.16 (0.15)	2.45 (2.22)	2.50 (2.27)	0.024 (0.022)	.0001 (.00009)	.008 (.007)	.001 (.0009)	0	0.0	0.0	0.0	0.0	19.35 (17.6)	0.16 (0.15)	2.45 (2.2)	2.50 (2.3)
San Francisco Bay Area	54.46 (49.4)	2.66 (2.4)	28.60 (25.9)	14.59 (13.2)	0.024 (0.022)	.0001 (.00009)	.008 (.007)	.001 (.0009)	0	0.0	0.0	0.0	0.0	54.46 (49.4)	2.66 (2.41)	28.60 (25.9)	14.59 (13.2)
San Joaquin	76.98 (69.8)	0.45 (0.4)	4.29 (3.9)	15.96 (14.5)	0.024 (0.022)	.0001 (.00009)	.008 (.007)	.001 (.0009)	0	0.0	0.0	0.0	0.0	76.98 (69.8)	0.45 (0.41)	4.29 (3.9)	15.96 (14.5)
Mojave Desert	24.63 (22.3)	3.15 (2.9)	3.77 (3.4)	6.18 (5.6)	0.024 (0.022)	.0001 (.00009)	.008 (.007)	.001 (.0009)	0	0.0	0.0	0.0	0.0	24.63 (22.3)	3.15 (2.86)	3.77 (3.4)	6.18 (5.6)
South Coast	67.57 (61.3)	0.52 (0.5)	25.49 (23.1)	8.93 (8.1)	0.024 (0.022)	.0001 (.00009)	.008 (.007)	.001 (.0009)	0	0.0	0.0	0.0	0.0	67.57 (61.3)	0.52 (0.47)	25.49 (23.1)	8.93 (8.1)
San Diego County	19.65 (17.83)	1.69 (1.53)	8.42 (7.64)	3.81 (3.46)	0.024 (0.022)	.0001 (.00009)	.008 (.007)	.001 (.0009)	0	0.0	0.0	0.0	0.0	19.65 (17.8)	1.69 (1.53)	8.42 (7.6)	3.81 (3.5)
Statewide (on-road mobile only)	310.94 (282.1)	9.25 (8.4)	76.61 (69.5)	58.26 (52.9)	0.024 (0.022)	.0001 (.00009)	.008 (.007)	.001 (.0009)	0	0.0	0.0	0.0	0.0	310.94 (282.1)	9.25 (8.39)	76.61 (69.5)	58.26 (52.9)

* Flight emissions from FAA EDMS model. Flight emission information is for default 737 and associated ground support.

No Project Alternative Compared to High-Speed Train Alternative (Sensitivity Analysis Variations in Ridership Forecast)

The proposed HST Alternative (with sensitivity analysis forecasts) would have the capacity to accommodate an estimated 68 million annual trips that would otherwise use roadways and airports statewide. The highway component is based on potential VMT reductions resulting from 42.7 million annual trips. The air travel component is based on potential reductions from 25.3 million trips.

Roadways: The proposed HST Alternative could potentially take the place of a 42.7 million city-to-city annual trips using on-road mobile sources and would therefore potentially reduce VMT on the state highway system compared to the No Project and Modal Alternatives. Changes in VMT and estimated on-road mobile source emission reductions resulting from the use of the proposed HST have been calculated for each of the five air basins (Table 3.3-6). The highest on-road mobile source emission reductions are predicted for the San Joaquin Valley Air Basin. The HST Alternative is predicted to reduce the 2020 CARB CO mobile source emission budget for San Joaquin Valley Air Basin by about 3.3% or 9.8 tons (8.9 metric tons). The South Coast Air Basin would receive the next highest potential pollutant reductions (on-road mobile source only), followed by the San Francisco Bay Area, San Diego County, Sacramento Valley, and Mojave Desert Air Basins.

Air Travel: The air-travel component is based on 25.3 million trips (1 trip = 1 takeoff and 1 landing) being shifted from the airplane component of No Project future conditions to the proposed HST. The emission burden reductions projected from the reduced number of flights, shown in Table 3.3-7, was calculated by determining the number of flights that could be accommodated by the proposed HST and multiplying that number by the emission estimates of an average flight, as described above in the discussion of methods of evaluating impacts. The emission changes by air basin resulting from the reduced number of flights range from an estimated 17% reduction in NO_x in the Sacramento Valley Air Basin to no change in the Mojave Desert Air Basin. The South Coast Air Basin is projected to have the largest potential reductions, followed by San Francisco Bay Area, San Diego County, Sacramento Valley, and San Joaquin Valley Air Basins. No reductions would be expected in the Mojave Desert Air Basin.

Statewide, an estimated 99% reduction is predicted in the plane portion of the CO_2 budget estimated for the No Project Alternative. This is approximately 37% of the calculated CO_2 budget for the No Project. CO_2 calculations for No Project Alternative reflect only emissions from electrical power stations, planes, and a portion of on-road VMT. For the plane portion of CARB's projected 2020 emission burden budgets, an 8% reduction is predicted in NO_x, a 6% reduction is predicted in CO, a 2% reduction in TOG, and a 1% reduction in PM10.

Train Travel and Electrical Power: Conventional rail service is not predicted to increase under the proposed HST Alternative therefore no change in pollutant burdens is predicted due to train travel.

Additional electrical power would be required to operate the HST system. Because of the nature of electrical power generation and the use of a grid system to distribute electrical power, it is not yet clear which facilities would be supplying power to the HST system. Emission changes from power generation can therefore be predicted on a statewide level only. As shown in Table 3.3-8, CO, PM10, NO_x, and TOG burden levels would be predicted to increase because of the power requirements of the proposed HST Alternative. A 11.6% increase representing approximately 14 tons (13 metric tons) statewide daily is predicted in the electric utilities portion of the CO 2020 CARB emission burden projection. This increase would represent less than 0.2% of the overall CO budget for the State of California.

Summary of Pollutants by Alternative: Table 3.3-9 summarizes the combined source categories for the existing conditions and No Project, Modal, and HST (with sensitivity analysis forecasts) Alternatives. Compared to the No Project Alternative, the HST Alternative (with sensitivity analysis forecasts) is predicted to decrease the amount of pollutants statewide in all air basins analyzed. Potential air quality benefits range from medium to low. CO_2 levels are also detailed in Table 3.3-9. CO_2 burden levels were estimated based on energy projections developed for each alternative.

Local Impacts: A total of 508 local screenline locations were analyzed. The general trend in screenline data shows that the level of service in the vicinity of proposed HST station locations would degrade under the HST Alternative. Capacity improvements under the Modal Alternative would generally prevent degradation in level of service at the proposed station sites, but V/C ratios would increase slightly. A V/C ratio is the comparison of the roadway volume to roadway capacity. A V/C of 1.0 would indicate a roadway at capacity. As the alternatives are refined and more in-depth studies are undertaken in future analyses, intersections near proposed HST station locations and any location where volumes would likely increase and V/C ratios degrade should be screened to determine if more detailed local analyses should be conducted to insure that the project does not cause a violation of the ambient air quality standards.

Table 3.3-6
On-Road Mobile Source Regional Emissions Analysis—No Project Alternative and HST Sensitivity Analysis Alternative

Air Basin	No Project VMT (Km) 2020 (in millions)	HST Sensitivity Analysis Alt. VMT (Km) 2020 (in millions)	No Project Emission Burden in Tons (Metric Tons)/Day				HST Sensitivity Analysis Alternative Emission Burden in Tons (Metric Tons)/Day				Incremental Change from No Project in Tons (Metric Tons)/Day and % Reduction from No Project			
			CO	PM10	NO_x	TOG	CO	PM10	NO_x	TOG	CO	PM10	NO_x	TOG
Sacramento Valley	84.079 (135.312)	83.832 (134.914)	187.28 (169.90)	3.79 (3.44)	35.85 (32.52)	26.12 (23.7)	186.73 (169.40)	3.78 (3.43)	35.74 (32.42)	26.04 (23.6)	-0.55 (0.50)/ 0.29 %	-0.01 (0.01)/ 0.3 %	-0.11 (0.10)/ 0.3 %	-0.078 (0.07)/ 0.29 %
San Francisco Bay Area	213.901 (344.240)	212.734 (342.362)	522.13 (473.38)	10.71 (9.72)	101.30 (91.90)	66.81 (60.6)	519.28 (471.09)	10.65 (9.66)	100.75 (91.40)	66.45 (60.28)	-2.85 (2.56)/ 0.52 %	-0.06 (0.05)/ 0.5 %	-0.55 (0.50)/ 0.5 %	-0.37 (0.33)/ 0.55 %
San Joaquin	135.617 (218.254)	131.132 (211.037)	297.28 (269.69)	6.78 (6.15)	68.28 (61.94)	36.68 (33.3)	287.45 (260.78)	6.56 (5.95)	66.02 (58.89)	35.47 (32.18)	-9.83 (8.92)/ 3.3 %	-0.22 (0.20)/ 3.3 %	-2.26 (2.05)/ 3.3 %	-1.21 (1.10)/ 3.2 %
Mojave Desert	44.681 (71.907)	44.671 (71.891)	95.33 (86.48)	2.07 (1.88)	15.82 (14.35)	9.81 (8.9)	95.31 (86.47)	2.07 (1.88)	15.82 (14.35)	9.81 (8.90)	-0.02 (.02)/ 0.02 %	0.0 (0.0)/ 0.0 %	-.004 (.003)/ 0.0 %	-0.002 (0.002)/ 0.02 %
South Coast	402.116 (647.143)	398.682 (641.617)	944.92 (857.23)	19.57 (17.75)	180.01 (163.31)	121.67 (110.4)	936.85 (849.91)	19.40 (17.60)	178.47 (161.91)	120.63 (109.44)	-8.07 (7.32)/ 0.85 %	-0.17 (0.15)/ 0.9 %	-1.54 (1.40)/ 0.9 %	-1.04 (0.94)/ 0.85 %
San Diego County	97.542 (156.977)	97.013 (156.127)	224.86 (204.00)	4.77 (4.33)	41.48 (37.63)	28.45 (25.8)	223.64 (202.89)	4.74 (4.30)	41.25 (37.42)	28.30 (25.67)	-1.22 (1.11)/ 0.53 %	-0.03 (0.02)/ 0.5 %	-0.23 (0.20)/ 0.5 %	-0.154 (.14)/ 0.54 %
Statewide (on-road mobile only)	1,109.510 (1,785.583)	1,088.880 (1,752.382)	2649.61 (2403.7)	53.58 (48.61)	515.11 (467.31)	341.44 (309.8)	2,627.07 (2,383.29)	53.09 (48.16)	438.06 (397.4)	338.59 (307.17)	-22.54 (20.5)/ 0.85 %	-0.49 (0.44)/ 0.9 %	-4.68 (4.25)/ 0.9 %	-2.85 (2.59)/ 0.85 %

Table 3.3-7
Airplane Emission Burdens—No Project Alternative and HST Sensitivity Analysis Alternative

	2020 Airplanes—No Project in Tons (Metric Tons)/Day				2020 Emissions Burden per Flight in Tons (Metric Tons)/Day*				Number of Planes Removed	2020 Additional Emissions Burden—HST Sensitivity Analysis Alternative in Tons (Metric Tons)/Day				2020 Total Plane Emissions Burden—HST Sensitivity Analysis Alternative in Tons (Metric Tons)/ Day and % Change from No Project			
Air Basin	CO	PM10	NO_x	TOG	CO	PM10	NO_x	TOG		CO	PM10	NO_x	TOG	CO	PM10	NO_x	TOG
Sacramento Valley	19.35 (17.55)	0.16 (0.15)	2.45 (2.22)	2.50 (2.27)	0.024 (0.022)	.0001 (.0001)	.008 (.007)	.001 (.0009)	-52	-1.26 (-1.2)	-0.003 (-0.003)	-0.41 (-0.4)	-0.07 (-0.1)	18.09 (16.4)/ -7%	0.16 (0.2)/ -2%	2.05 (1.86)/ -17%	2.43 (2.20)/ -3%
San Francisco Bay Area	54.46 (49.41)	2.66 (2.41)	28.60 (25.95)	14.59 (13.24)	0.024 (0.022)	.0001 (.0001)	.008 (.007)	.001 (.0009)	-297	-7.22 (-6.5)	-0.018 (-0.02)	-2.31 (-2.1)	-0.38 (-0.4)	47.24 (42.8)/ -13%	2.64 (2.4)/ -1%	26.29 (23.9)/ -8%	14.21 (12.9)/ -3%
San Joaquin	76.98 (69.84)	0.45 (0.41)	4.29 (3.89)	15.96 (14.48)	0.024 (0.022)	.0001 (.0001)	.008 (.007)	.001 (.0009)	-15	-0.37 (-0.4)	-0.001 (-0.001)	-0.12 (-0.1)	0.02 (.02)	76.62 (69.5)/ 0%	0.45 (0.4)/ 0%	4.17 (3.8)/ -3%	15.94 (14.4)/ 0%
Mojave Desert	24.63 (22.34)	3.15 (2.86)	3.77 (3.42)	6.18 (5.61)	0.024 (0.022)	.0001 (.0001)	.008 (.007)	.001 (.0009)	0	0.0	0.0	0.0	0.0	24.60 (22.3)/ 0%	3.15 (2.9)/ 0%	3.77 (3.42)/ 0%	6.18 (5.61)/ 0%
South Coast	67.57 (61.30)	0.52 (0.47)	25.49 (23.12)	8.93 (8.10)	0.024 (0.022)	.0001 (.0001)	.008 (.007)	.001 (.0009)	-305	-7.42 (-6.7)	-0.018 (-0.02)	-2.37 (-2.2)	-0.39 (-0.4)	60.16 (54.6)/ -11%	0.50 (0.5)/ -4%	23.12 (21.0/ -9%	8.54 (7.75)/ -4%
San Diego County	19.65 (17.83)	1.69 (1.53)	8.42 (7.64)	3.81 (3.46)	0.024 (0.022)	.0001 (.0001)	.008 (.007)	.001 (.0009)	-102	-2.48 (-2.25)	-0.006 (-0.005)	-0.79 (-0.72)	-0.13 (-0.1)	17.17 (15.6)/ -13%	1.68 (1.5)/ 0%	7.63 (6.9)/ -9%	3.68 (3.3)/ -3%
Statewide (on-road mobile only)	310.94 (282.09)	9.25 (8.39)	76.61(6 9.50)	58.26 (52.85)	0.024 (0.022)	.0001 (.0001)	.008 (.007)	.001 (.0009)	-771	-18.74 (-17.0)	-0.05 (-0.04)	-6.0 (-5.4)	-0.98 (-0.9)	292.2 (265.1)/ -6%	9.20 (8.4)/ -1%	70.61 (64.1)/ -8%	57.28 (51.9)/ -2%

Table 3.3-8
Electrical Power Station Emissions—No Project Alternative and HST Sensitivity Analysis Alternative

	No Project Emission Burden—Electric in Tons (Metric Tons)/Day				HST Sensitivity Analysis Alternative Emission Burden—Electric in Tons (Metric Tons)/Day				Incremental Change from No Project in Tons (Metric Tons)/Day and % Change from No Project			
Air Basin	**CO**	**PM10**	**NO_x**	**TOG**	**CO**	**PM10**	**NO_x**	**TOG**	**CO**	**PM10**	**NO_x**	**TOG**
Statewide	120.1 (109.)	10.5 (9.6)	71.9 (65.3)	36.8 (33.4)	134.1 (121.7)	10.6 (9.6)	72.1 (65.4)	37.9 (34.4)	14. (12.7)/ 11.6 %	0.02 (.02)/ 0.19 %	0.14 (.13)/ 0.19 %	1.09 (.99)/ 2.96 %

Table 3.3-9
Potential Impacts on Air Quality Statewide—Existing, No Project, Modal, and HST Sensitivity Analysis Alternatives

	Sacramento Valley Air Basin	San Francisco Bay Area Air Basin	San Joaquin Valley Air Basin	Mojave Desert Air Basin	South Coast Air Basin	San Diego County Air Basin	Statewide
Existing (2002) on-road mobile, trains, planes, and electrical utilities* emission burdens in tons (metric tons)/day							
CO	726.8 (659.35)	1,841.27 (1,670.4))	1,142.85 (1,036.8)	339.47 (307.9)	3,468.44 (3,146.5)	795.49 (721.7)	9,726.42 (8,823.8)
PM10	4.24 (3.8)	12.14 (10.9)	7.0 (6.4)	5.12 (4.6	19.74 (17.9)	6.19 (5.6)	66.29 (60.14)
O_3 precursor—NO_x	153.93 (139.6)	360.42 (326.9)	245.74 (222.93)	80.49 (72.9)	691.62 (627.43)	142.63 (129.39)	1,978.6 (1,795.00)
O_3 precursor—TOG	83.63 (75.8)	211.69 (192.0)	126.1 (114.4)	36.57 (33.2)	379.26 (344.1)	85.24 (77.3)	1,109.06 (1,006.1)
No project on-road mobile, trains, planes, and electrical utilities* emission burdens in tons (metric tons)/day							
CO	208.62 (189.26)	578.00 (524.36)	376.75 (341.79)	126.32 (114.60)	1,017.37 (922.96)	244.70 (221.99)	3,101.17 (2,813.39)
PM10	4.20 (3.81)	13.50 (12.2)	7.46 (6.77)	5.68 (5.15)	20.59 (18.7)	6.49 (5.89)	75.37 (68.4)
O_3 precursor—NO_x	46.24 (41.95)	134.58 (122.10)	80.78 (73.28)	33.99 (30.84)	217.91 (197.7)	50.77 (46.06)	722.97 (655.9)
O_3 precursor—TOG	29.06 (26.36)	81.72 (74.14)	53.21 (48.27)	17.54 (15.91)	131.83 (119.6)	32.31 (29.31)	466.24 (423)
CO_2	N/A	N/A	N/A	N/A	N/A	N/A	1,438,816.9 (1,305,272.7)
Modal Alternative (2020) burden in tons (metric tons)/day and % change in CO, PM10, NO_x, TOG, CO_2 emission burdens compared to No Project							
CO	210.68 (191.13)/ 0.99 %	583.74 (529.6)/ 0.99 %	380.0 (344.7)/ 0.87 %	127.4 (115.6)/ 0.83 %	1,027.8(932.9)/ 1.02 %	247.2 (224.2)/ 1.01 %	3,126.2 (2,836.1)/ 0.81 %
PM10	4.24 (3.85)/ 0.99 %	13.62 (12.4)/ 0.87 %	7.53 (6.84)/ 1.00 %	5.70 (5.17)/ 0.40 %	20.81 (18.9) / 1.05 %	6.54 (5.94) / 0.81 %	75.89 (68.9) / 0.70 %
O_3 precursor—NO_x	46.63 (42.31) / 0.85 %	135.69 (123.1) / 0.83 %	81.53 (73.97) / 0.93 %	34.16 (30.99) / 0.51 %	219.89 (199.5) / 0.91 %	51.23 (46.47) / 0.90 %	727.8 (660.3) / 0.67 %
O_3 precursor—TOG	29.35 (26.62) / 0.99 %	82.45 (74.8) / 0.90 %	53.61 (48.64) / 0.76 %	17.65 (16.01) / 0.62 %	133.2 (120.8) / 1.02 %	32.62 (29.6) / 0.97 %	469.4 (425.9) / 0.68 %
CO_2	N/A	N/A	N/A	N/A	N/A	N/A	1,439,163.08 (1,305,586.78) / 0.00 %

	Sacramento Valley Air Basin	San Francisco Bay Area Air Basin	San Joaquin Valley Air Basin	Mojave Desert Air Basin	South Coast Air Basin	San Diego County Air Basin	Statewide
Potential Modal Impacts*							
CO	Medium -	Medium -	Medium -	Medium -	Medium -	Medium -	Medium -
PM10	Low -	Low -	Low -	Low -	Medium -	Low -	Medium -
NO_x	Medium -	Medium -	Medium -	Low -	Medium -	Medium -	Medium -
TOG	Medium -	Medium -	Medium -	Low -	Medium -	Medium -	Medium -
CO_2	Medium -	Medium -	Medium -	Medium -	Medium -	Medium -	Medium -
HST Alternative (2020) burden in tons (metric tons) and % change in CO, PM10, NO_x, TOG, CO_2 emission burdens compared to No Project							
CO	206.81 (187.62) / -0.87 %	567.93 (515.23) / -1.74 %	366.55 (332.54) / -2.71 %	126.30 (114.58) / -0.02 %	1,001.89 (908.91) / -1.52 %	241.00 (218.64) / -1.51 %	3,073.86 (2,788.62) / -0.88 %
PM10	4.19 (3.8) / -0.34 %	13.42 (12.2) / - 0.56 %	7.23 (6.56) / - 3.02 %	5.68 (5.15) / - 0.01 %	20.40 (18.5) / - 0.90 %	6.46 (5.86) / - 0.49 %	74.86 (67.9) / -0.68 %
O_3 precursor—NO_x	45.73 (41.49) / -1.10 %	131.7 (119.5) / - 2.13 %	78.41 (71.13) / - 2.94 %	33.99 (30.83) / - 0.01 %	214.0 (194.1) / - 1.79 %	49.75 (54.13) / - 2.01 %	712.4 (646.3) / -1.46 %
O_3 precursor—TOG	28.92 (26.23) / -0.49 %	80.98 (73.46) / - 0.91 %	51.98 (47.15) / - 2.32 %	17.54 (15.91) / - 0.01 %	130.4 (118.3) / - 1.08 %	32.03 (29.05) / - 0.88 %	463.5 (420.5) / -0.59 %
CO_2	N/A	N/A	N/A	N/A	N/A	N/A	1,418,265.15 / -1.43 %
Potential HST Regional Impacts*							
CO	Medium +	Medium +	Medium +	Low +	Medium +	Medium +	Medium +
PM10	Low +	Low +	Low +	Low +	Low +	Low +	Medium +
NO_x	Medium +	Medium +	Medium +	Low +	Medium +	Medium +	Medium +
TOG	Medium +	Medium +	Medium +	Low +	Medium +	Medium +	Medium +
CO_2	N/A	N/A	N/A	N/A	N/A	N/A	Low +

	Sacramento Valley Air Basin	San Francisco Bay Area Air Basin	San Joaquin Valley Air Basin	Mojave Desert Air Basin	South Coast Air Basin	San Diego County Air Basin	Statewide

Notes:

Potential impacts determined using threshold levels and attainment status detailed in Section 3.3.1.

+ = Benefit to air quality.

- = Deterioration in air quality.

N/A = Not Applicable.

CO_2 is analyzed only on a statewide level.

* Emission burdens from electrical utilities are included only in the statewide totals. CO_2 burdens do not include train emissions.

No Project Alternative Compared to High-Speed Train Alternative (Investment-Grade Ridership Forecasts)

The proposed HST Alternative, using investment-grade ridership forecasts, would potentially accommodate an estimated 42 million annual trips, which would otherwise use roadways and airports statewide. The highway component is based on potential VMT reductions from 26.6 million annual trips. The air-travel component is based on 15.4 million trips.

Roadways: The proposed HST Alternative (using investment-grade ridership forecasts) would accommodate city-to-city trips, reducing VMT on the state highway system compared to the No Project and Modal Alternatives. Changes in VMT and on-road mobile source emission burdens have been calculated for each potentially affected air basin (Table 3.3-10) resulting from the estimated 26.6 million vehicle trips that would use the proposed HST Alternative. The highest on-road mobile source emission burden reductions are projected for the San Joaquin Valley Air Basin. The proposed HST system is predicted to reduce the 2020 CARB CO mobile source emissions for the San Joaquin Valley Air Basin by approximately 1.6% or 4.75 tons (4.31metric tons) daily. The South Coast Air Basin would have the next highest predicted pollutant burden reductions (on-road mobile source only), followed by the San Francisco Bay Area, San Diego County, Sacramento Valley, and Mojave Desert Air Basins.

Air Travel: The HST Alternative would replace city-to-city trips using off-road mobile (air) travel modes. The air-travel component is based on 15.4 million trips (1 trip = 1 takeoff and 1 landing) from the airplane component of No Project conditions. The emissions projected to be saved from the reduced flights, shown in Table 3.3-11, were calculated by determining the number of flights that could be reduced by the proposed HST and multiplying that number by the emission estimates for an average flight, as described above in the discussion of methods of evaluating impacts. The emission burdens by air basin calculated for the reduced flights would range from a 10% reduction in NO_x for the Sacramento Valley Air Basin to no change in the Mojave Desert Air Basin. The South Coast Air Basin is projected to have the largest burden reductions, followed by San Francisco Bay Area, San Diego County, Sacramento Valley, and San Joaquin Valley Air Basins. No reductions would be expected in the Mojave Desert Air Basin.

Statewide, a 60% reduction is projected in the plane portion of the CO_2 budget estimated for No Project. This reduction would be approximately 23% of the calculated CO_2 budget for the No Project Alternative. CO_2 calculations for the No Project Alternative reflect only emissions from electrical power stations, planes, and a portion of on-road VMT. For the plane portion of CARB's projected 2020 emission budgets, a 5% reduction is projected in NO_x; a 4% reduction is predicted in CO; a 1% reduction in TOG; and a reduction of less than 1% in PM10.

Train Travel and Electrical Power: Conventional rail service is not predicted to increase under the proposed HST Alternative.

Additional electrical power would be required to operate the proposed HST system. Because of the nature of electrical power generation and the use of a grid system to distribute electrical power, it is not yet clear which facilities would be supplying power to the proposed HST system. Emission changes from power generation can therefore be predicted on a statewide level only. As shown in Table 3.3-12, CO, PM10, NO_x, and TOG burden levels are predicted to increase statewide because of the power requirements of the HST. A 9.9% increase in emissions representing approximately 12 tons (11 metric tons) daily is predicted in the electric utilities portion of the CO 2020 CARB emission projection. This increase would represent less than 0.2% of the overall CO budget for the State of California.

Table 3.3-10
On-Road Mobile Source Emission Regional Analysis—No Project Alternative and HST Investment-Grade Ridership Forecast Alternative

Air Basin	No Project VMT (Km) 2020 (in millions)	HST Investment -Grade Ridership Forecast Alt. VMT (Km) 2020 (in millions)	No Project Emission Burden in Tons (Metric Tons)/Day				HST Investment-Grade Ridership Forecast Alternative Emission Burden in Tons (Metric Tons)/Day				Incremental Change from No Project in Tons (Metric Tons)/Day and % Reduction from No Project			
			CO	PM10	NO_x	TOG	CO	PM10	NO_x	TOG	CO	PM10	NO_x	TOG
Sacramento Valley	84.079 (135.312)	83.948 (135.101)	187.28 (169.90)	3.79 (3.44)	35.85 (32.52)	26.12 (23.7)	186.99 (169.64)	3.78 (3.43)	35.79 (32.47)	26.08 (23.66)	-0.29 (0.26) / -0.2 %	-0.01 (0.01) / -0.2 %	-0.06 (0.05) / -0.2 %	-0.04 (0.04) / -0.2 %
San Francisco Bay Area	213.901 (344.240)	213.215 (343.136)	522.13 (473.38)	10.71 (9.72)	101.30 (91.90)	66.81 (60.6)	520.45 (472.16)	10.68 (9.68)	100.97 (91.60)	66.60 (60.42)	-1.68 (1.52) / -0.3 %	-0.03 (0.03) / -0.3 %	-0.33 (0.29) / -0.3 %	-0.21 (0.19) / -0.3 %
San Joaquin Valley	135.617 (218.254)	133.449 (214.765)	297.28 (269.69)	6.78 (6.15)	68.28 (61.94)	36.68 (33.3)	292.53 (265.38)	6.67 (6.05)	67.19 (60.95)	36.09 (32.74)	-4.75 (4.31) / -1.6 %	-.11 (0.10) / -1.6 %	-1.09 (0.99) / -1.6 %	-0.59 (0.53) / -1.6 %
Mojave Desert	44.681 (71.907)	44.673 (71.894)	95.33 (86.48)	2.07 (1.88)	15.82 (14.35)	9.81 (8.9)	95.31 (86.47)	2.07 (1.88)	15.82 (14.35)	9.81 (8.90)	-0.02 (0.02) / 0.0 %	0.00 (0.00) / 0.0 %	0.00 (0.00) / 0.0 %	-0.002 (0.002) / 0.0 %
South Coast	402.116 (647.143)	399.899 (643.575)	944.92 (857.23)	19.57 (17.8)	180.01 (163.3)	121.67 (110.4)	939.71 (852.51)	19.46 (17.66)	179.02 (162.41)	121.00 (109.8)	-5.21 (4.73) / -0.6 %	-0.11 (0.10) / -0.6 %	-0.99 (0.90) / -0.6 %	-0.67 (0.61) / -0.6 %
San Diego County	97.542 (156.977)	97.279 (156.555)	224.86 (204.00)	4.77 (4.33)	41.48 (37.63)	28.45 (25.8)	224.25 (203.44)	4.76 (4.32)	41.37 (37.53)	28.37 (25.74)	-0.61 (0.55) / -0.3 %	-0.01 (0.01) / -0.3 %	-0.11 (0.10) / -0.3 %	-0.67 (0.61) / -0.6 %
Statewide (on-road mobile only)	1,109.510 (1,785.583)	1,104.036 (1,776.774)	2649.61 (2403.7)	53.58 (48.6)	515.11 (467.3)	341.44 (309.8)	2637.06 (2,392.3)	53.31 (48.3)	512.53 (464.97)	339.85 (308.3)	-12.55 (11.39) / -0.5 %	-0.27 (0.24) / -0.5 %	-2.58 (2.34) / -0.5 %	-1.59 (1.44) / -0.5 %

Table 3.3-11
Airplane Emission Burdens—No Project Alternative and HST Investment-Grade Ridership Forecast Alternative

	2020 Planes—No Project in Tons (Metric Tons)/Day				2020 Emission Burden per Flight in Tons (Metric Tons)/Day*				# of Planes Removed by HST Invest-ment Grade Rider-ship Forecast Alt.	2020 Additional Emission Burden—HST Investment-Grade Ridership Forecast Alternative in Tons (Metric Tons)/Day				2020 Total Plane Emissions Burden—HST Investment-Grade Ridership Forecast Alternative in Tons (Metric Tons)/Day and % Change from No Project			
Air Basin	**CO**	**PM10**	**NO_x**	**TOG**	**CO**	**PM10**	**NO_x**	**TOG**		**CO**	**PM10**	**NO_x**	**TOG**	**CO**	**PM10**	**NO_x**	**TOG**
Sacramento Valley	19.35 (17.55)	0.16 (0.15)	2.45 (2.22)	2.50 (2.27)	0.024 (0.022)	.0001 (.0001)	.008 (.007)	.001 (.0009)	31	-0.75 (-0.68)	-0.002 (-0.002)	-0.241 (-0.219)	-0.039 (-0.035)	18.596 (16.87)/ -4 %	0.16 (0.14)/ -1 %	2.21 (2.000)/ -10 %	2.46(2.23)/ -2 %
San Francisco Bay Area	54.46 (49.41)	2.66 (2.41)	28.60 (25.95)	14.59 (13.24)	0.024 (0.022)	.0001 (.0001)	.008 (.007)	.001 (.0009)	181	-4.4 (-4.0)	-0.011 (-0.010)	-1.408 (-1.277)	-0.230 (-0.209)	50.06 (45.41)/ -8 %	2.65 (2.40)/ 0 %	27.192 (24.67)/ -5 %	14.36 (13.03)/ -2 %
San Joaquin Valley	76.98 (69.84)	0.45 (0.41)	4.29 (3.89)	15.96 (14.48)	0.024 (0.022)	.0001 (.0001)	.008 (.007)	.001 (.0009)	9	-0.219 (-0.199)	-0.001 (-0.001)	-0.070 (-0.064)	-0.011 (-0.010)	76.76 (69.64)/ 0 %	0.45 (0.41)/ 0 %	4.220 (3.83)/ -2 %	15.95 (14.47)/ 0 %
Mojave Desert	24.63 (22.34)	3.15 (2.86)	3.77 (3.42)	6.18 (5.61)	0.024 (0.022)	.0001 (.0001)	.008 (.007)	.001 (.0009)	0	0.00	0.00	0.00	0.00	24.63 (22.34)/ 0 %	3.15 (2.86)/ 0 %	3.77 (3.42)/ 0 %	6.18 (5.61)/ 0 %
South Coast	67.57 (61.30)	0.52 (0.47)	25.49 (23.12)	8.93 (8.10)	0.024 (0.022)	.0001 (.0001)	.008 (.007)	.001 (.0009)	186	-4.522 (-4.102)	-0.011 (-0.010)	-1.447 (-1.313)	-0.236 (-0.214)	63.05 (57.20)/ -7 %	0.51 (0.46)/ -2 %	24.04 (21.81)/ -6 %	8.69 (7.89)/ -3 %
San Diego County	19.65 (17.83)	1.69 (1.53)	8.42 (7.64)	3.81 (3.46)	0.024 (0.022)	.0001 (.0001)	.008 (.007)	.001 (.0009)	62	-1.507 (-1.367)	-0.004 (-0.004)	-0.482 (-0.437))	-0.079 (-0.072)	18.14 (16.46)/ -8 %	1.69 (1.53)/ 0 %	7.94 (7.20)/ -6 %	3.73 (3.39)/ -2 %
Statewide (on-road mobile only)	310.94 (282.09)	9.25 (8.39)	76.61 (69.50)	58.26 (52.85)	0.024 (0.022)	.0001 (.0001)	.008 (.007)	.001 (.0009)	469	-11.40 (-10.34)	-0.028 (-0.025)	-3.649 (-3.310)	-0.596 (-0.541)	299.54 (271.74)/ -4 %	9.22 (8.37)/ 0 %	72.96 (66.19)/ -4 %	57.66 (52.31)/ -1 %

Table 3.3-12
Electrical Power—No Project Alternative and HST Investment-Grade Ridership Forecast Alternative

	No Project Emission Burden—Electric in Tons (Metric Tons)/Day				HST Investment-Grade Ridership Forecast Alternative Emission Burden—Electric in Tons (Metric Tons)/Day				Incremental Change from No Project in Tons (Metric Tons)/Day/Percent Change from No Project			
Air Basin	**CO**	**PM10**	**NO_x**	**TOG**	**CO**	**PM10**	**NO_x**	**TOG**	**CO**	**PM10**	**NO_x**	**TOG**
Statewide	120.1 (108.96)	10.53 (9.55)	71.92 (65.25)	36.79 (33.38)	132.0 (67.01)	10.5 (5.55)	72.0 (34.88)	37.7 (36.43)	11.88 (10.78)/9.9 %	0.02 (0.02)/ 0.16 %	0.12 (0.11)/ 0.16 %	1.93 (0.84)/ 2.51 %

Table 3.3-13
Potential Impacts on Air Quality Statewide—Existing, No Project, Modal, and HST Investment-Grade Ridership Alternatives

	Sacramento Valley Air Basin	San Francisco Bay Area Air Basin	San Joaquin Valley Air Basin	Mojave Desert Air Basin	South Coast Air Basin	San Diego Air Basin	Statewide
Existing (2002) on-road mobile, trains, planes, and electrical utilities* emission burdens in tons (metric tons)/day							
CO	726.8 (659.35)	1,841.27 (1,670.4))	1,142.85 (1,036.8)	339.47 (307.9)	3,468.44 (3,146.5)	795.49 (721.7)	9,726.42 (8,823.8)
PM10	4.24 (3.8)	12.14 (10.9)	7.0 (6.4)	5.12 (4.6	19.74 (17.9)	6.19 (5.6)	66.29 (60.14)
O_3 precursor—NO_x	153.93 (139.6)	360.42 (326.9)	245.74 (222.93)	80.49 (72.9)	691.62 (627.43)	142.63 (129.39)	1,978.6 (1,795.00)
O_3 precursor—TOG	83.63 (75.8)	211.69 (192.0)	126.1 (114.4)	36.57 (33.2)	379.26 (344.1)	85.24 (77.3)	1,109.06 (1,006.1)
No Project (2020) on-road mobile, trains, planes, and electrical utilities* emission burdens in tons (metric tons)/day							
CO	208.62 (189.26)	578.00 (524.36)	376.75 (341.79)	126.32 (114.60)	1,017.37 (922.96)	244.70 (221.99)	3,101.17 (2,813.39)
PM10	4.20 (3.81)	13.50 (12.2)	7.46 (6.77)	5.68 (5.15)	20.59 (18.7)	6.49 (5.89)	75.37 (68.4)
O_3 precursor—NO_x	46.24 (41.95)	134.58 (122.10)	80.78 (73.28)	33.99 (30.84)	217.91 (197.7)	50.77 (46.06)	722.97 (655.9)
O_3 precursor—TOG	29.06 (26.36)	81.72 (74.14)	53.21 (48.27)	17.54 (15.91)	131.83 (119.6)	32.31 (29.31)	466.24 (423)
CO_2	N/A	N/A	N/A	N/A	N/A	N/A	1,438,816.9 (1,305,272.7)
Modal Alternative (2020) burden in tons (metric tons)/day and % change in CO, PM10, NO_x, TOG, CO_2 emission burdens compared to No Project							
CO	210.68 (191.13)/ 0.99 %	583.74 (529.6)/ 0.99 %	380.0 (344.7)/ 0.87 %	127.4 (115.6)/ 0.83 %	1,027.8(932.9)/ 1.02 %	247.2 (224.2)/ 1.01 %	3,126.2 (2,836.1)/ 0.81 %
PM10	4.24 (3.85)/ 0.99 %	13.62 (12.4)/ 0.87 %	7.53 (6.84)/ 1.00 %	5.70 (5.17)/ 0.40 %	20.81 (18.9) / 1.05 %	6.54 (5.94) / 0.81 %	75.89 (68.9) / 0.70 %
O_3 precursor—NO_x	46.63 (42.31) / 0.85 %	135.69 (123.1) / 0.83 %	81.53 (73.97) / 0.93 %	34.16 (30.99) / 0.51 %	219.89 (199.5) / 0.91 %	51.23 (46.47) / 0.90 %	727.8 (660.3) / 0.67 %
O_3 precursor—TOG	29.35 (26.62) / 0.99 %	82.45 (74.8) / 0.90 %	53.61 (48.64) / 0.76 %	17.65 (16.01) / 0.62 %	133.2 (120.8) / 1.02 %	32.62 (29.6) / 0.97 %	469.4 (425.9) / 0.68 %
CO_2	N/A	N/A	N/A	N/A	N/A	N/A	1,439,163.08 (1,305,586.78)/ 0.00 %
Potential Modal Impacts*							
CO	Medium -	Medium -	Medium -	Medium -	Medium -	Medium -	Medium -
PM10	Low -	Low -	Low -	Low -	Medium -	Low -	Medium -

	Sacramento Valley Air Basin	San Francisco Bay Area Air Basin	San Joaquin Valley Air Basin	Mojave Desert Air Basin	South Coast Air Basin	San Diego Air Basin	Statewide
NO_x	Medium -	Medium -	Medium -	Low -	Medium -	Medium -	Medium -
TOG	Medium -	Medium -	Medium -	Low -	Medium -	Medium -	Medium -
CO_2	N/A	N/A	N/A	N/A	N/A	N/A	Low -
HST Investment Grade Alternative (2020) burden in tons (metric tons)/day and % change in CO, PM10, NO_x, TOG, CO_2 emission burdens compared to No Project							
CO	207.58 (188.31) / -0.50 %	571.92 (518.85) / -1.05 %	371.78 (337.28) / -1.32 %	126.30 (114.58) / -0.01 %	1007.64 (914.13) / -0.96 %	242.59 (220.07) / -0.86 %	3089.10 (2802.44) / -0.39 %
PM10	4.19 (3.80) / -0.18 %	13.45 (12.21) / -0.34 %	7.35 (6.67) / -1.46 %	5.68 (5.15) / -0.01 %	20.47 (18.57) / -0.58 %	6.47 (5.87) / -0.26 %	75.09 (68.12) / -0.37 %
O_3 precursor—NO_x	45.94 (41.68) / -0.64 %	132.85 (120.52) / -1.29 %	79.62 (72.23) / -1.44 %	33.99 (30.83) / --0.01 %	215.5 (195.5) / -1.12 %	50.18 (45.52) / -1.17 %	716.9 (650.3) / -0.85 %
O_3 precursor—TOG	28.98 (26.29) / -0.28 %	81.28 (73.73) / -0.54 %	52.61 (47.73) / -1.12 %	17.54 (15.91) / -0.01 %	130.9(118.8) / -0.69 %	32.15 (29.17) / -0.48 %	464.98 (421.8) / -0.27 %
CO_2	N/A	N/A	N/A	N/A	N/A	N/A	1,432,412.18 (1,299,488.38)/-0.45 %
Potential HST Investment Grade Regional Impacts*							
CO	Medium +	Medium +	Medium +	Low +	Medium +	Medium +	Medium +
PM10	Low +	Low +	Low +	Low +	Low +	Low +	Low +
NO_x	Medium +	Medium +	Medium +	Low +	Medium +	Medium +	Medium +
TOG	Low +	Medium +	Medium +	Low +	Medium +	Medium +	Medium +
CO_2	N/A	N/A	N/A	N/A	N/A	N/A	Low +

Notes:
Potential Impacts determined using threshold levels and attainment status as detailed in Section 3.3.1.
+ = Benefit to air quality
- = Deterioration in air quality
N/A = Not Applicable
CO_2 is analyzed only on a statewide level.

* Emission burdens from electrical utilities are included only in the statewide totals. CO_2 burdens do not include train emissions.

Summary of Pollutants by Alternatives: Table 3.3-13 summarizes the combined source categories for existing conditions and the No Project, Modal, and HST Alternatives. Compared to the No Project Alternative, the proposed HST Alternative (with investment-grade ridership forecasts) is projected to result in a decrease in the amount of pollutants statewide and in all air basins analyzed. Potential air quality benefits would range from a medium to a low rating.

Local Impacts: A total of 508 local screenline locations were analyzed. The general trend in screenline data shows that the level of service in the vicinity of proposed HST station locations would degrade under the HST Alternative. Capacity improvements under the Modal Alternative would generally prevent degradation in level of service at the proposed station sites, but V/C ratios would increase slightly. As the alternatives are refined and more in-depth studies are undertaken in future analyses, intersections near proposed HST station locations and any location where volumes would likely increase and V/C ratios degrade should be screened to determine if more detailed local analyses should be conducted to insure that the project does not cause a violation of the ambient air quality standards.

3.3.4 Design Practices

The HST system would use electrical propulsion to serve the forecast ridership, which is primarily diverted from highway or air travel. The HST Alternative is estimated to have a beneficial effect on the emissions levels throughout the air basins involved. In addition, the Authority will pursue the identification and utilization of energy produced from clean/efficient sources to the extent possible.

As described in Section 3.1 Traffic and Circulation, utilizing existing/planned multimodal hubs for station locations would also minimize air emission increases in and around station areas.

3.3.5 Mitigation Strategies and CEQA Significance Conclusions

Based on the analysis above, and considering the CEQA Appendix G thresholds of significance for air quality, the proposed HST system alternative would have a less than significant effect on air quality when viewed on a systemwide basis. Continued improvements in air pollution controls on vehicles, as new vehicles replace older vehicles, will result in an overall reduction of the average air pollutant emissions per vehicle mile of operation in the future. Use of the proposed HST system, however, would reduce vehicle miles otherwise traveled and result in an air quality benefit when viewed on a systemwide basis. Temporary, short-term increases in emissions associated with construction activities would be reduced with the application of mitigation strategies. The potential for localized air pollutant increases associated with traffic near proposed HST stations would be addressed by mitigation strategies discussed in section 3.1.6, as well as design practices, applied to reduce these impacts. See section 3.1.6.

The program-level analysis in this document reviews the potential statewide air quality impacts of a proposed HST system and the analysis would support determination of conformity for the proposed HST system. At the project level potential mitigation strategies should be explored to address potential localized impacts. Emissions from power plants supplying power to the proposed HST system could be controlled at those power plants as required under air pollution control permits. The proposed HST system could be designed to use state-of-the-art, energy-efficient equipment to minimize potential air pollution impacts associated with power used by the proposed HST system. Potential localized impacts could be addressed at the project level by promoting the following measures.

- Increase use of public transit.
- Increase use of alternative-fueled vehicles.
- Increase parking for carpools, bicycles, and other alternative transportation methods.

Potential construction impacts, which should be analyzed once more detailed project plans are available, can be mitigated by following local and state guidelines.

Potential mitigation strategies for air quality impacts associated with the HST Alternative would focus on the alleviation of traffic congestion around passenger station areas as described in the Traffic and Circulation section and on the reduction of air emissions during the construction process. The potential strategies listed below are related to the reduction of air emissions during construction.

- Water all active construction areas at least twice daily.
- Cover all trucks hauling soil, sand, and other loose materials or require that all trucks maintain at least two feet of freeboard.
- Pave, apply water three times daily, or apply (non-toxic) soil stabilizers on all unpaved access roads, parking areas and staging areas at construction sites.
- Sweep daily (with water sweepers) all paved access roads, parking areas and staging areas at construction sites.
- Sweep streets daily (with water sweepers) if visible soil material is carried onto adjacent public streets.
- Hydroseed or apply (non-toxic) soil stabilizers to inactive construction areas (previously graded areas inactive for ten days or more).
- Enclose, cover, water twice daily or apply (non-toxic) soil binders to exposed stockpiles (dirt, sand, etc.).
- Limit traffic speeds on unpaved roads to 15 miles per hour.
- Install sandbags or other erosion control measures to prevent silt runoff to public roadways.
- Replant vegetation in disturbed areas as quickly as possible.
- Use alternative fuels for construction equipment when feasible.
- Minimize equipment idling time.
- Maintain properly tuned equipment.

The proposed HST system alternative is expected to result in an air quality improvement when viewed on a systemwide basis. Temporary, short-term emissions increases associated with construction activities, and potential localized air pollution increases associated with traffic near proposed HST stations would be substantially reduced by the application of mitigation strategies and design practices. See section 3.1.6 for further discussion of mitigation strategies for increased traffic near stations. At the second-tier, project-level review, applications of these mitigation strategies are expected to reduce localized air quality impacts to a less-than-significant level in most locations. Additional environmental assessment will allow more precise evaluation in the second-tier, project-level environmental analyses.

3.3.6 Subsequent Analysis

More detail on the impact of the potential changes in vehicle hours traveled (VHT) in the regional analysis should be available for the next phase of the environmental analysis. HST alignment options should also be refined for the next phase of analysis. Once alignments are selected, if a decision is made to proceed with the proposed HST system, then local traffic counts could be conducted at access roads serving major station locations. These counts would provide more accurate information for determining potential local air quality hotspot locations. Hotspots are areas where the potential for elevated pollutant levels

exist. Once hotspot locations (if any) are determined, a detailed analysis following the guidelines at the time of analysis should be conducted.

Potential construction impacts and potential mitigation measures should also be addressed in subsequent analyses. Once an alternative and alignment is established a full construction analysis should be conducted. This analysis should quantify emissions from construction vehicles, excavation, worker trips, and other related construction activities. Mitigation measures, if required, should be detailed and a construction monitoring program, if required should be established.

3.4 NOISE AND VIBRATION

This section identifies potential noise and vibration impacts on sensitive receptors or receivers, such as people in residential areas, schools, and hospitals, for the No Project, Modal, and High-Speed Train (HST) Alternatives. This analysis generally describes the sensitive noise receptors in the five regions and the methodology for determining the potential noise and vibration impacts on those receptors for each alternative. The differences in potential impacts of all three alternatives are compared to each other. This comparison considers the potential noise impacts from airplanes, automobiles on intercity highways, and the proposed HST system. The section also discusses the potential benefits of adding grade separations[1] for existing railroads in some areas, thereby reducing noise generated at grade crossings. Since this is a program-level environmental document, the analysis of potential noise and vibration impacts broadly compares the relative differences in potential impacts between the alternatives and HST alignment options.

3.4.1 Regulatory Requirements and Methods of Evaluation

A. REGULATORY REQUIREMENTS

Noise and vibration are among the environmental issues to be evaluated for a proposed HST project under NEPA and CEQA. The FRA has a regulation governing compliance with the Noise Emission Regulation adopted by the U.S. Environmental Protection Agency (EPA) for noise emissions from interstate railroads. The FRA's Railroad Noise Emission Compliance Regulation (49 C.F.R. Part 210) prescribes minimum compliance regulations for enforcement of the railroad noise emission standards adopted by the EPA (40 C.F.R. Part 201). The FRA has also established criteria for assessment of noise and vibration impacts for high-speed ground transportation projects (U.S. Department of Transportation 1998). The methodology and impact criteria for noise and vibration from the FRA guidance manual have been used in the assessment of the HST Alternative.

Assessment of the components comprising the No Project and Modal Alternatives are based on relevant criteria adopted by the U.S. Department of Transportation Federal Highway Administration (FHWA), Federal Aviation Administration (FAA), and Federal Transit Administration (FTA), each of which has established criteria for assessing noise impacts. As described below, each agency's criteria were used to define a screening distance for assessing the potential for noise impact from relevant sources. The FRA and FTA have also established vibration impact criteria related to rail transportation. The other transportation agencies have not established vibration criteria for the transportation modes under their jurisdiction, airports and highways.

At the state level, the California Noise Control Act was enacted in 1973 (Health and Safety Code § 46010 *et seq.*) and provides for the Office of Noise Control in the Department of Health Services to 1) provide assistance to local communities developing local noise control programs, and 2) work with the Office of Planning and Research to provide guidance for the preparation of the required noise elements in city and county general plans, pursuant to Government Code § 65302(f). In preparing the noise element, a city or county must identify local noise sources and analyze and quantify to the extent practicable current and projected noise levels for various sources, including highways and freeways, passenger and freight railroad operations, ground rapid transit systems, commercial, general, and military aviation and airport operations, and other ground stationary noise sources. Noise level contours must be mapped for these sources, using both community noise equivalent level (CNEL) and day-night average level (L_{dn}) and are to be used as a guide in land use decisions to

[1] For this analysis, a grade separation is the literal separation, using overpasses or underpasses, of the rail and roadway components of an at-grade crossing. This eliminates the need for trains to blow horns or sound warning devices at the grade separated (previous grade crossing) locations.

minimize the exposure of community residents to excessive noise. Airports are subject to the noise requirements set by the FAA and noise standards under C.C.R. Title 21, § 5000.

B. METHOD OF EVALUATION OF IMPACTS

Two basic evaluation techniques were used for this analysis: a screening analysis for each travel mode (highway, air, and HST) and more specific analysis of typologies derived from representative locations for the proposed HST Alternative. The screening analysis for each travel mode provides a basis for a comparison of relative differences in potential noise impacts between the No Project, Modal, and HST Alternatives. The representative typologies were used to verify screening level assumptions and to provide a basis for comparison of HST options, including consideration of the potential effectiveness of mitigation and the potential impacts or benefits associated with grade separation of existing rail lines.

Screening Procedure

Transportation noise impacts are assessed according to the number of people and noise-sensitive land uses potentially impacted by new noise sources from a project. However, for a statewide project such as the proposed HST Alternative (especially before many project-level details have been defined) it is not possible to develop a specific measure of the potential noise impacts because information necessary for performing a detailed noise analysis is not available. Consequently, a screening method was used to develop a general estimate of the relative potential for impact among alternatives. Screening distances were applied from the center of potential alignments to estimate all potentially impacted land uses in noise-sensitive environmental settings. Appendix 3.4-A defines the screening distances used. The number of people and noise-sensitive land uses were tabulated within the defined screening distance. Appendix 3.4-B describes the rating methods used to determine these numbers. The method is conservative in that it overestimates the potential impact. The method identifies all potentially impacted developed lands by type of use within the study area, but subsequent project-level analysis using better-defined system parameters and affected populations is likely to indicate lower levels of potential impact. Because potential noise impacts decrease dramatically if a structure blocks the path to the receptor, this is a conservative approach.

Noise screening analyses were performed for the No Project, Modal, and HST Alternatives. Screening distances were selected for the HST, railroads, highways, and airports based on criteria established by the agencies that regulate these modes.

- FRA and FTA for HST and conventional rail (see Appendix 3.4-C).
- FHWA for highways.
- FAA for aircraft and airports.

The analyses were accomplished using available GIS data for land use and alignment geometry for each alternative. The number of people potentially affected and the area of noise-sensitive land uses within the screening distance were determined using GIS and census data.

The potential impacts were subsequently combined to develop an impact rating for each HST and highway sub-segment assessed for the No Project, Modal, and HST Alternatives (Appendix 3.4-B). The impact rating for each segment is described as low, medium, or high, as an indication of the potential for noise impact.

Application of Screening Method to Highway and Air Modes

Highway noise impact measures used by FHWA are slightly different from the other transportation modes. Highway noise impact is based on the traffic equivalent noise level (L_{eq})

during 1 hour of the day, the hour with the greatest impact on a regular basis. For comparison with the proposed HST Alternative, the potential impacts associated with peak hourly L_{eq} are methodologically equivalent with impacts based on the FRA and FAA modal-specific criteria based on L_{dn} and CNEL. This is because, despite the different ways of measuring noise impacts, the FHWA, FRA, FTA, and FAA criteria are based on similar patterns of negative reaction exhibited by people exposed to gradations of noise from the different transportation modes. Screening distances for highways were calculated for various roadway types by number of lanes, using the FHWA traffic noise model to determine the distance at which the noise contour of 65 A-weighted decibels (dBA) L_{eq} is reached. Highway noise screening distances are described in Appendix 3.4-A.

The screening distances were applied to all of the highway segments that would be improved (additional lanes) under the highway component of the Modal Alternative. In general, the highway-related noise is a function of the volume and speed of traffic (given a representative mix of autos, trucks, and buses) and the road surface. The additional capacity (lanes) added as part of the Modal Alternative would increase both the volume and speed of traffic on the improved highway segments.

Aviation noise was assessed using the CNEL figure used in California, and noise impact would be considered to occur where CNEL exceeds 65 dBA, which is the equivalent to the 65-dBA L_{dn} contour used by the FAA for impact purposes. Noise contours around airports are routinely developed to identify the area and number of people exposed to noise levels in excess of the 65-dBA L_{dn} impact threshold.

For each of the airport improvements (additional gates and runways) that would be part of the aviation component of the Modal Alternative, the 65-dBA L_{dn} noise contour was redrawn and reassessed and overlaid with census data to assess the potential for noise impact. In general, airport noise contours expand around an airport depending on the number of operations of each type of aircraft. A 40% increase in number of flights will result in about a 17% increase in area enclosed by a given noise contour, (i.e., the 65-dBA CNEL noise contour). New runways result in new noise contours, encompassing relatively large areas of previously unexposed land uses—often including homes and other sensitive receptors to aircraft noise. While this area might increase the number of people potentially affected, it would not necessarily increase the severity of potential impact.

Vibration is assumed not to be an issue with highways or aviation primarily because there are no FHWA or FAA regulations that mandate its consideration.

Application of Screening Method to Conventional Rail and High-Speed Train Modes

Railroad noise and vibration criteria developed by FTA are consistent with criteria adopted by the FRA for high-speed trains. They were used to assess conventional rail operations in the No Project and Modal Alternatives as well as the HST Alternative.

Criteria for HST noise impact assessment are based on activity interference and annoyance ratings developed by EPA. These criteria, described and presented in graphical form in Appendix 3.4-C, provide the basis for the rail noise analysis procedures used in the screening and the representative typologies (U.S. Department of Transportation 1998).

The screening procedure used by the FRA takes into account the noise impact criteria, the type of corridor, and the ambient noise conditions in typical communities. Distances within which potential impacts may occur are defined based on operations of a typical HST system. These distances were developed from detailed noise models based on empirical measurements of noise emissions of existing steel-wheel/steel-rail high-speed trains, expected maximum operation levels

and speeds, and residential land use. The width of the potential impact along the length of the HST alignment is the area in which there is potential for noise impact. The FRA screening procedure was developed for HST speeds from 125 mph to 210 mph (201 kph to 338 kph). For speeds less than 125 mph (201 kph) and for areas near stations, the FTA screening method was used in concert with the FRA method. The FRA and FTA screening distances for noise are included in Appendix 3.4-A.

The screening distances are different for the different types of developed areas along a potential alignment according to their estimated existing ambient noise. "Urban" and "noisy suburban" areas are grouped together. These areas are assumed to have ambient noise levels greater than 60 dBA L_{dn}. Similarly, "quiet suburban" and "rural" or "natural open-space" areas are grouped as areas where ambient noise levels are less than 55 dBA L_{dn}. For developed land with L_{dn} between 55 and 60 dBA, the classification is dependant on other factors such as proximity of major transportation facilities and density of population. The screening procedure was applied to first allow for the comparison of impacts between alternatives and to identify areas of potential impacts for further consideration in project-level analysis. The screening procedure estimates the affected receptors to ensure that all potential impacts are included at the program level.

While the screening procedure is based on the type of equipment (technology and power type), operational characteristics of the new services (speeds and frequencies), the type of support structure (aerial or at grade), and the general ambient noise level, it does not address the horn and bell noise associated with existing passenger and freight trains because these are regarded as part of the existing environment and are assumed to be held constant for all three alternatives. To develop a relative comparison of the HST and Modal Alternatives, the results of the screening analysis were adjusted to account for noise reductions from the elimination of grade crossings on existing rail lines, where the HST alignment options would share the rail corridor. The degree of adjustment was based on the representative typologies for similar circumstances and is defined in the following section.

As a final step for those areas rated medium or high for potential impacts, the screening analysis assessed the potential use of noise barriers and other mitigation options to assess the potential for reducing noise impacts. The mitigation analysis is discussed in Section 3.4.5.

Vibration impact screening was performed for the HST Alternative only. The highway and aviation modes are assumed to cause less-than-significant ground-borne vibration, and neither FHWA nor FAA have adopted vibration impact assessment criteria. The vibration screening procedure is used to compare potential impacts among regional HST alignment design options and to provide an estimate of the length of alignments where consideration of vibration attenuation features may be appropriate.

Representative Typologies for High-Speed Trains

To better understand the potential impacts of the HST Alternative, several noise impact assessment studies were prepared for representative situations of noise- and vibration-sensitive land uses. The more detailed General Assessment Method of FTA's and FRA's guidance manuals were used to provide noise impact estimations. The FRA and FTA noise impact criteria of *severe impact*, *impact* and *no impact* were applied to the results. These typological studies verified the general results from the screening procedure. Representative situations were chosen to provide a range of potential impact types and levels. This approach provides a means of considering at the program level the potential impacts on communities along any potential proposed HST alignment. The typology locations are illustrated on maps by region in Appendix 3.4-F.

Developed land use categories consist of individual medium- and low-density residential zones, schools, hospitals, parks, and other unique institutional receptors such as museums, libraries, etc.

Residential land uses were chosen for the typologies for new and shared corridors that varied in local zoning densities, ambient noise conditions, set back distances from the alternative corridors, and HST operational speeds. Institutional uses as mentioned above and parks were individually identified for each focused study. These representative typologies were evaluated on the topics listed below.

- Verification of screening distances (noise and vibration).
- Effectiveness of noise barriers.
- Benefits from elimination of grade crossings.
- Costs and benefits of a high-speed downtown bypass loop.

Verification of Screening Distances (Noise and Vibration)

The results of the representative typologies confirm that the screening method used an appropriate upper boundary as an indicator of potential for noise impact. Impacts were found to occur in 90% of the cases identified in the screening procedure; in 75% of those studied, consideration of mitigation may be appropriate. Those that would have insignificantly low noise impact were either at outer edges of the screening distance or were shielded sufficiently by other buildings. Shielding by terrain features or buildings is not taken into account in the screening process, except to indicate some receptors would not need further analysis.

Representative studies were also completed that assess the range of the potential vibration impact levels that are likely to be encountered in project-level analyses. The results generally show that the nearer buildings would be to a proposed alignment, the greater the likelihood of impact. Where speeds are expected to be low, the vibration potential impacts are confined to within 100 ft (30 m) of the track. At top speeds, the potential impacts extend to 200 ft (61 m). The special typologies generally validate the vibration screening distances that are included in Appendix 3.4-A.

Effectiveness of Noise Barriers

Noise barriers are used extensively in Europe and Japan to mitigate noise impacts from HST systems. The representative typology studies generally indicated that mitigation by sound barrier walls can be an effective means of reducing the potential impacts by one category, for example, from severe impact (mitigation appropriate) to impact. Noise barrier mitigation is shown to be especially effective for receivers close to the tracks. While noise barrier walls would not be the only potential mitigation strategy to be considered, they were used to represent mitigation potential in this Program EIR/EIS.

Benefits from Elimination of Grade Crossings

The representative typology studies were also used to estimate the potential benefit of noise reduction resulting from grade separations. A focused noise study in the Bay Area to Merced region (at Charleston Road in Palo Alto) showed the potential benefit of eliminating horn blowing at a typical Caltrain grade crossing on the Peninsula. Assessment of noise impact from horns at grade crossings was performed with FRA's horn noise model and annoyance based criteria. The horn noise model indicated an 81% reduction in the number of people impacted within 0.25 mi (0.40 km) of that intersection by elimination of horn noise from commuter trains. Another focused noise study in the Los Angeles to San Diego via Orange County region showed similar results. The elimination of the grade crossing at Tamarak Street in Oceanside was analyzed and found to result in a 77% reduction in the number of people impacted in the vicinity. Although the results vary depending on the local population density and proximity of residences and other sensitive land uses at each grade crossing, they illustrate the magnitude of the potential change to be expected if the sounding of horns and bells at existing rail crossings could be eliminated.