2 ALTERNATIVES

This chapter describes the system-wide intercity transportation alternatives and the alignment options for the proposed high-speed train (HST) system considered in this tier 1/program-level environmental document. Because this is a program-level analysis considering the entire HST system and is intended to define broad differences between alternatives, the level of detail for alternatives is conceptual or general rather than project-specific (40 C.F.R. § 1508.28; 14 C.C.R. § 15385). Subsequent project-specific environmental documents and analysis would assess preliminary engineering information and provide more details on environmental impacts for alternatives carried forward.

The alternatives and design options discussed in this chapter are based on previous feasibility studies defining the project, the scoping process, and the HST alignment and station screening evaluation process. All alternatives that have been considered are described in this chapter, including those rejected from further consideration in this Program Environmental Impact Report/Environmental Impact Statement (Program EIR/EIS) and the basis for their rejection. The system alternatives—the No Project/No Action, Modal, and HST Alternatives—are described in detail in this chapter, and their development is summarized.

The following sections provide a brief synopsis of the system alternatives analyzed by the California High Speed Rail Authority (Authority) and the Federal Railroad Administration (FRA) in this Program EIR/EIS. In addition to the No Project/No Action Alternative, required by CEQA and NEPA, and the HST Alternative, the Authority and the FRA developed the Modal Alternative, which represents a potentially feasible alternative to the proposed HST system.

2.1 SUMMARY OF SYSTEM ALTERNATIVES

2.1.1 No Project Alternative

The No Project/No Action (No Project) Alternative represents the state's transportation system (highway, air, and conventional rail) as it is today and would be after implementation of programs or projects that are currently in regional transportation plans and have identified funds for implementation by 2020.

2.1.2 Modal Alternative

During the screening evaluation process, the Authority and the FRA developed several conceptual modal alternatives that focused on potential improvement to existing modes of intercity travel. Under these alternatives, the proposed HST system would not be implemented, and the existing transportation infrastructure would be expanded to accommodate the anticipated future intercity travel demand in the same geographic markets as the HST Alternative. The Modal Alternative analyzed in this Program EIR/EIS includes a combination of potentially feasible highway and aviation system improvements that focus on quantifiable capacity enhancements, primarily additional through lanes, passenger terminal gates, runways, and associated improvements. Existing conventional passenger rail was not included in this alternative because it would not meet the same intercity demand that would be served by the proposed HST system.

2.1.3 High-Speed Train Alternative

The Authority and the FRA developed a range of potential HST corridors, and alignment and station options within the corridors. Informed by previous studies and the scoping process, the Authority and the FRA evaluated the potential HST corridors and identified those that best met the project purpose and need. Through the screening process, reasonable and feasible alignment and station options were

identified. The proposed HST corridors and study regions used for all alternatives are shown in Figure 2.1-1.

Several train technologies and systems were also considered at the screening level. The HST train technology analyzed in this Program EIR/EIS is electrified steel-wheel-on-steel-rail dedicated service, with a maximum speed of 220 mph or 350 kph. The HST system would use electrically powered trains capable of maximum operating speeds of 220 mph [350 kph] using steel-wheel-on-steel-rail technology. A fully grade-separated, access-controlled right-of-way would be constructed, except where the system would be able to share tracks at lower speeds with other compatible passenger rail services. Shared-track operations would use existing rail infrastructure in areas where construction of new separate HST facilities would not be feasible. While shared service would reduce the flexibility and capacity of HST service because of the need to coordinate schedules, it would also result in fewer environmental impacts and a lower construction cost.

2.2 CHAPTER ORGANIZATION

The remainder of this chapter is organized into the following five sections.

- Section 2.3 describes the development of the alternatives.
- Section 2.4 describes the No Project Alternative.
- Section 2.5 describes the modal options considered and rejected, as well as the Modal Alternative carried forward for further consideration in this Program EIR/EIS.
- Section 2.6 describes the HST Alternative, including the technology, system-performance criteria, alignment, and station options considered and rejected, as well as those carried forward for further consideration in this Program EIR/EIS.
- Section 2.7 summarizes the alternatives analyzed in this Program EIR/EIS.

2.3 DEVELOPMENT OF ALTERNATIVES

This section describes the process used to evaluate conceptual alternatives presented in previous feasibility studies and identified through the scoping and screening process for a proposed California HST system, leading to the set of system alternatives and HST alignment options that are analyzed in this Program EIR/EIS. Key criteria used to distinguish among alternatives are described in Chapter 1 (*Purpose and Need and Objectives)*. Those criteria include connectivity, right-of-way constraints and compatibility, ridership potential, constructability, and environmental impacts.

2.3.1 Background

Since 1994, three planning and feasibility studies have been completed under the direction of the California Department of Transportation (Caltrans), the former California Intercity High Speed Rail Commission (Commission), and the current Authority. The specific scopes of work of the studies differed, but they all focused on identifying potential HST technologies and corridors and broadly evaluated their feasibility. These three studies culminated in the Authority's final business plan (Business Plan) for an economically viable HST system that would serve major metropolitan areas of California (California High Speed Rail Authority 2000).

These planning and feasibility studies considered environmental constraints and potential impacts, with the objective of avoiding or minimizing impacts on sensitive resources where possible. Most of the corridors considered follow existing highways or railroad lines, particularly in urban areas, to avoid or minimize environmental impacts. Many of the options for corridor and station locations emerged from

Figure 2.1-1 Study Regions

regional and local agency input. Potential station locations were identified for operational and ridership forecasting purposes, and alternative sites were considered as part of the corridor evaluation. However, specific station sites were not selected. The studies were done consecutively, such that each subsequent study benefited from and built on previous work to further refine and develop potential HST options. The scope, timing, and products of each of the three studies and the Business Plan are described below. The relationship between the studies is illustrated in Figure 2.3-1.

A. LOS ANGELES TO BAKERSFIELD PRELIMINARY ENGINEERING FEASIBILITY STUDY (1994)

Completed by Caltrans in 1994, this study analyzed the feasibility of constructing an HST system across the Tehachapi Mountains in southern California. The Tehachapi Mountains comprise one of the largest physical constraints (if not the largest physical constraint) to the development of a statewide HST network. The study produced an evaluation of the various HST technologies as well as engineering drawings, cost estimates, and preliminary environmental analysis for potential alignments traversing the Tehachapi Mountains. The study also produced drawings and cost estimates for potential stations, developed operating plans, and estimated travel times for this segment of a statewide system. The study is documented in the *Los Angeles–Bakersfield Preliminary Engineering Feasibility Study Final Report* (California Department of Transportation 1994).

Alignments were studied using then-current aerial photographs and maps at a scale of 1 inch (in) equals 200 feet (ft). The feasibility study included preliminary engineering analysis of several key technical issues (e.g., structures, tunneling, and unit capital costs). The corridors studied traversed a variety of terrain (e.g., urban development, mountains, and valley floor). Work performed for the Los Angeles to Bakersfield study provided an important foundation for the subsequent statewide corridor evaluation studies.

The feasibility study considered a broad range of alternative alignments and then focused on the most viable routes. Two main corridors between Los Angeles and Bakersfield were considered feasible in terms of cost, travel time, potential ridership, and environmental constraints: Interstate 5 (I-5)/Grapevine and Palmdale-Mojave (Antelope Valley).

B. CORRIDOR EVALUATION AND ENVIRONMENTAL CONSTRAINTS ANALYSIS (1996)

This study was conducted by the Commission in three phases and was completed in 1996. The first phase defined the most promising corridor alignments for linking the San Francisco Bay Area and Los Angeles (Figure 2.3-2). During the second phase, these alternative corridors between Los Angeles and the Bay Area were examined in more detail. The third phase examined potential HST system extensions to Sacramento, San Bernardino/Riverside, Orange County, and San Diego.

The study identified potential station locations; estimated travel times; developed construction, operation, and maintenance cost estimates; analyzed environmental constraints and possible mitigation measures; and, in an iterative process with a ridership study prepared for the Commission, developed a conceptual operating plan. The corridors considered in all phases of this study are described in the *High-Speed Rail Corridor Evaluation and Environmental Constraints Analysis Final Report* (California Intercity High Speed Rail Commission 1996).

This analysis was completed concurrently with studies addressing four other aspects of a proposed high-speed rail system: ridership and revenue projections, institutional and financial options, economic impacts and benefit/cost analysis, and public participation. The corridors recommended for study by the 1996 analysis are shown in Figure 2.3-3.

Figure 2.3-1:
Relationship between Previous California High-Speed Train Studies

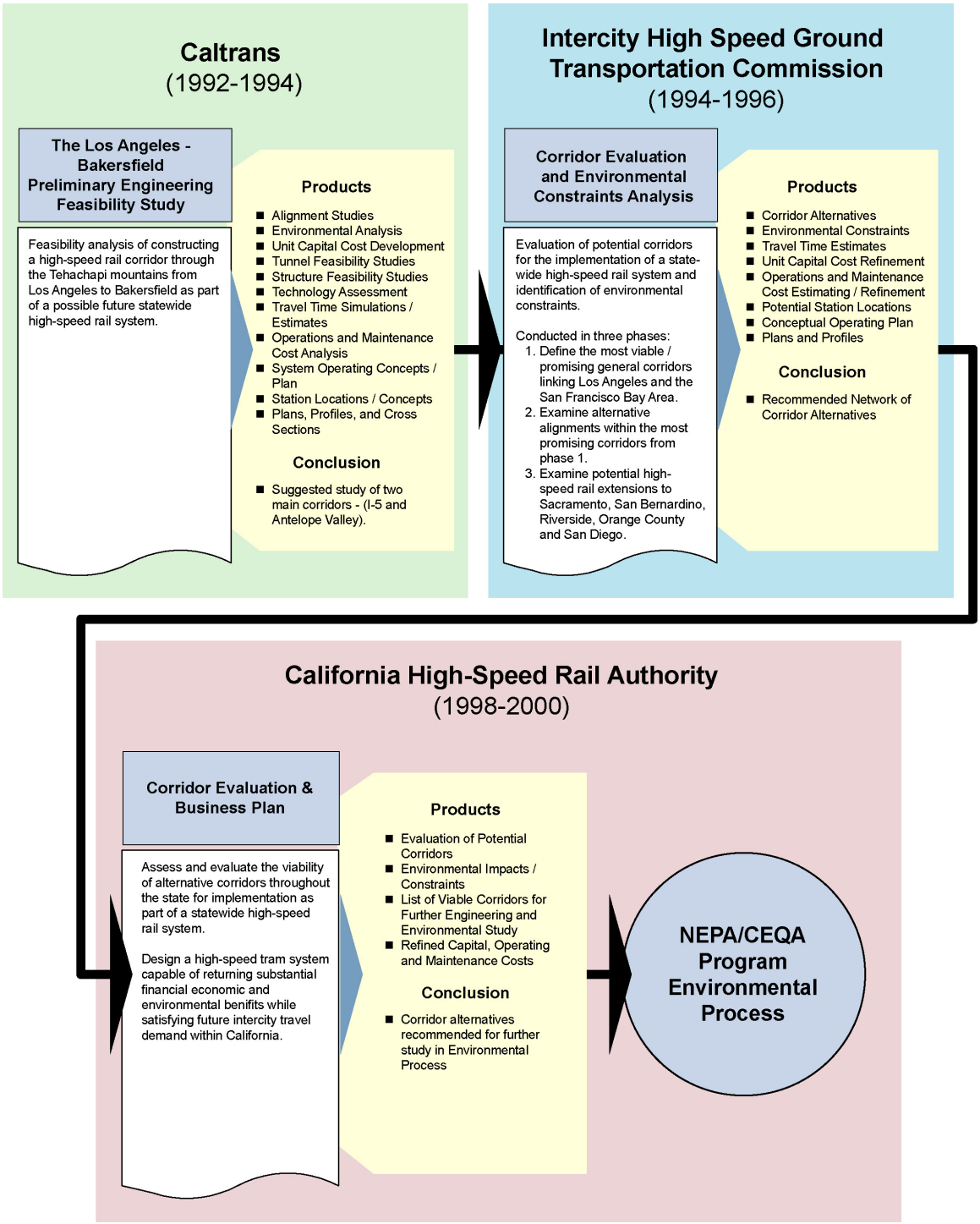

Figure 2.3-2: Initial Phase Corridors (Commission Studies, 1996)

Figure 2.3-3: Corridors for Continued Consideration (Commission Studies, 1996)

C. HIGH-SPEED RAIL CORRIDOR EVALUATION (1999)

In September 1998, the Authority initiated a study to evaluate the viability of various corridors throughout the state for a statewide HST system. The Authority was legislatively mandated to move forward in a manner that was consistent with and continued the work of the Commission. Potential corridors were evaluated for capital, operating, and maintenance costs; travel times; and engineering, operational, and environmental constraints. This study is documented in the *California High-Speed Rail Corridor Evaluation Final Report* (California High Speed Rail Authority 1999).

This study provided the Authority with a basis for recommending a potentially feasible network of HST corridors for further study. While previous studies had been limited in the number of alternatives that could be analyzed in certain areas of the state, other potential corridors and new issues were identified in the 1999 study as regional and local agencies provided their input on the recommendations of the previous studies. Two corridor alternatives were not recommended for study as part of this evaluation: the Altamont Pass corridor and the Los Angeles-Orange County-San Diego (LOSSAN) corridor as a dedicated line.

D. BUSINESS PLAN

The Business Plan presents a reasoned approach for constructing, operating, and financing an efficient and economically viable statewide HST system capable of speeds up to 220 mph (350 kph) that would be electrically powered and fully grade-separated, and link California's major metropolitan areas. The Business Plan was based on the analysis from the *High-Speed Rail Corridor Evaluation* (1999) as well as ridership and revenue, cost-benefit, financial planning, and system integration studies.

The Business Plan concluded that "a high-speed train system is a smart investment in the state's future mobility. It will yield solid financial returns to the state and provide potentially dramatic transportation benefits to all Californians. It is a system that can be operated without public subsidy. The public's investment should be limited to that which is necessary to ensure the construction of the basic system."

The analysis and objectives summarized in the Business Plan found that an HST system would be able to:

- Return twice as much financial benefit to the state's citizens as it costs.
- Carry at least 32 million intercity passengers and another 10 million commuters annually.
- Generate about $900 million in revenues and return an operational surplus of more than $300 million per year.

The Authority recommended initiating a formal environmental review process with a system-wide program-level EIR/EIS on the HST network described in the Business Plan.

2.3.2 Formulation of Alternatives

With the initiation of the high-speed rail (HSR) program environmental review, the Authority and the FRA began the process of defining reasonable and feasible alternatives to be considered in this Program EIR/EIS. This effort involved the development of an HST Alternative (including design options) and other system alternatives focused on other intercity modes of transportation. The process involved consideration of the purpose and need for the proposed action and consultation with public agencies and the public, as described below.

A. AGENCY AND PUBLIC CONSULTATION AND SCOPING

Early steps to define the project and alternatives to be carried forward in this Program EIR/EIS involved consultation with public agencies and obtaining comment from the public. Sixteen public town hall meetings were held between February and April 2001, with professionally facilitated discussions to obtain public input. Information from these town hall meetings regarding HST alignments and station options was used in the preparation of scoping materials and presentations and incorporated into the screening evaluation.

Further agency and public input was obtained during the scoping process pursuant to CEQA and NEPA. The notice of preparation (NOP) was released April 6, 2001, and the notice of intent (NOI) was published in the Federal Register on May 2, 2001. Written comments were received in response to these notifications.

Scoping activities for this Program EIR/EIS were conducted during the scoping period between April 6, 2001, and May 31, 2001. Due to the geographical extent and complexity of the proposed project, many scoping meetings were held. A statewide agency and public scoping meeting was held on April 24, 2001, in Sacramento to obtain public and agency input. A series of nine additional scoping meetings followed throughout the state as well as other meetings, briefings, and involvement activities.

The Program EIR/EIS scoping process identified areas of potential concern related to the proposed HST system. Many comments indicated the need for an improved statewide transportation system that is reliable, cost effective, and easy to use. Many comments also emphasized the need for an HST system to connect to existing transportation systems, including airports. Providing for potential freight service was also a frequent theme. Issues of concern about the environment typically focused on potential noise and visual impacts, safety, and impacts on air quality and sensitive habitats. The potential for growth inducement was also raised. The scoping process and outcomes, including comments and concerns pertaining to each region, are documented in the *California High-Speed Train Statewide Scoping Report* (California High Speed Rail Authority 2002).

B. AGENCY INVOLVEMENT

Following the issuance of the NOI and NOP and the scoping meetings, the Authority and the FRA formed a working group of representatives from 27 federal and state agencies to assist in the environmental review process. The interagency group has met periodically during the Program EIS/EIR development to discuss major issues from the perspective of these agencies and to provide input to the lead agencies to help focus the analysis and streamline the review process.

The federal and state agency representatives included in this process were asked to provide input for the following specific areas.

- Scope of the Program EIR/EIS.
- Purpose and need statement.
- Technical methods of analysis and study area definition.
- Substantive issues of particular concern.
- Sources of information and data relevant to their agencies.
- Avoidance, minimization, and mitigation strategies.
- Decisions at major milestones in the environmental process.

- Screening and definition of alternatives to be analyzed in the Program EIR/EIS.
- Procedural requirements and permits or approvals necessary for subsequent phases of environmental review.

The Authority also invited input from regional and local agencies in areas potentially affected by the proposed HST system. Meetings of the Authority governing board have provided a forum for providing information about the environmental process. These meetings have been held in major cities in the project area to provide a convenient opportunity for regional and local participation and input.

As discussed in Section 1.1, the FRA is the lead federal agency for NEPA compliance, and federal cooperating agencies include the Federal Highway Administration (FHWA), Federal Transit Administration (FTA), Federal Aviation Administration (FAA), U.S. Army Corps of Engineers (USACE), U.S. Environmental Protection Agency (EPA), and the U.S. Fish and Wildlife Service (USFWS). The FRA developed a memorandum of understanding (MOU) with the federal cooperating agencies to clarify expectations for the preparation and review of the Program EIR/EIS and for Clean Water Act Section 404 review. The memorandum of understanding (MOU) is included as Appendix 1-A. The federal cooperating agencies have met during the environmental review process to provide input to the Program EIR/EIS, and their involvement is expected to continue throughout the program environmental process.

C. ALTERNATIVES DEVELOPMENT

In 1997, the FRA published *High-Speed Ground Transportation for America,* a national study examining the commercial feasibility of new high-speed ground transportation systems (Federal Railroad Administration 1997). This commercial feasibility study uniformly applied economic principles to weigh likely investment needs, operating performance, and social benefits of different types of train services in regional travel markets. The Authority followed these principles and in the Business Plan defined a practical approach to construct, operate, and finance an HST system that would yield solid financial returns to the state and provide potentially dramatic transportation benefits to all Californians. The development of the alternatives considered in this Program EIR/EIS incorporated the principles set forth in the Business Plan to minimize capital and operating costs while maximizing total benefits.

The FRA and the Authority recognize that the HST system would require a commitment of substantial resources, and that this Program EIR/EIS should address the broad issues related to the development of a proposed HST system. Based on the information developed in the earlier studies discussed above, as well as through public and agency coordination and scoping, the Authority and the FRA were able to identify potential corridors for development of a proposed HST system. To obtain a thorough understanding of potential impacts, the Authority and the FRA also decided to consider other potential transportation improvements that could serve as an alternative to the proposed HST in addressing the purpose and need.

In the State of California, there are conventional passenger trains and commercial intercity buses, but air and highway travel are clearly the predominant modes for intercity trips, particularly for trips over 150 miles (mi) (240 kilometers [km]). Because the No Project Alternative would likely not satisfy the projected increased intercity travel demand, the Authority, the FRA, and cooperating agencies concluded it was appropriate to consider a potentially feasible modal alternative that could respond to the level of increased representative demand for intercity travel that the proposed HST Alternative could serve. The Modal Alternative considered herein focuses on currently available intercity modes of transportation and consists of hypothetical future improvements to a combination of highways and airports serving the same geographic areas as the proposed HST Alternative. The Modal Alternative

was developed to provide a similar level of capacity to serve a "representative demand"[1] for intercity travel. The Modal Alternative was developed to meet demand, not capacity, to provide a realistic comparison between alternatives.

Intercity Travel Demand

Population in California is projected to increase 30% by the year 2020. That growth equates to more than 11 million people (U.S. Census Bureau 2000; California Department of Finance 1998). Because of trends in travel demand, congestion, and other adverse travel conditions, the market for intercity travel in California that the proposed HST system could serve is projected to grow by up to 63% over the next 20 years. According to the intercity travel demand forecasts prepared by Charles River Associates for the Authority, the HST system would carry at least 32 million passengers per year by 2020. These estimates are conservatively based on costs, travel times, and congestion levels for air and automobile transportation from 1997 to 2000. Analyses performed as part of the independent ridership and revenue forecasts prepared for the Authority (Charles River Associates 2000), using assumptions of increased growth of intercity trips, costs, and congestion of air and automobile travel, resulted in potential ridership for intercity HST system almost twice as high (more than 58 million annual intercity passengers for 2020). The proposed system is also forecast to carry nearly 38,000 commuters every weekday by 2020, or about 10 million commuter passengers annually.

These ridership forecasts were prepared in 1999–2000 for the Business Plan. They were based on the identified "highest return on investment route" for purposes of economic and financial analysis and are the best projections currently available for a representative HST system.[2] 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 are long-distance commuters) for 2020, with a potential for considerably higher ridership beyond 2020. The purpose of and need for this project is to meet a part of California's future intercity travel demand in 2020 and beyond. While the HST system would have the capacity to carry many more passengers than the projected ridership by using longer trains, double-decker cars, or more frequent service (e.g., the Tokaido system in Japan carries more than 130 million passengers annually), the system alternatives are based on the higher ridership forecast because it provides a reasonable estimate of the number of passengers that might be expected to be carried in 2020 or beyond.

For this Program EIR/EIS, the higher ridership forecast of 58 million intercity trips (based on the sensitivity analysis as described in Chapter 1), together with the 10 million commute trips figure, 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.

HST Alternative Development

The Authority and the FRA started developing the HST alternative by seeking to identify the most reasonable and practicable HST technologies, corridors, alignments, and stations for analysis in this Program EIR/EIS. As part of this process, HST technologies and corridors previously

[1] The *representative demand* is approximately 58 million intercity trips (the higher forecast) and 10 million long-distance commute trips, totaling 68 million annual trips. The 68 million annual trips primarily represent trips that could be diverted from another mode (i.e., auto or air) to an HST system, if it were available.

[2] The route identified as having the highest return on investment was the 700-mi (1,127-km) system selected to represent the best investment opportunities and was used by the Authority in preparation of the full-funding scenario presented in the Business Plan.

considered were reevaluated and a screening evaluation of potential HST alignment and station options was conducted. This screening evaluation analyzed all reasonable and practical alignment and station options for viable technologies within viable HST corridors.

The evaluation of potential HST corridors, technologies, alignments, and stations used the following standardized criteria.

- Construction: Substantial engineering and construction complexity as well as excessive initial and/or recurring costs were considered criteria for project impracticability because they present logistical constraints.
- Environment: A high potential for considerable impacts on natural resources, including waters, streams, floodplains, wetlands, and habitat of threatened or endangered species was considered a criterion for failing to meet project objectives.
- Land Use Compatibility: Substantial incompatibility with current or planned local land use as defined in local plans was considered a criterion for failing to meet project objectives.
- Right-of-Way: A lack of available right-of-way or extensive right-of-way needs that would result in excessively high acquisition costs for a corridor, technology, alignment, or station was considered criteria for project impracticability.
- Connectivity/Accessibility: Limited connectivity with other transportation modes (aviation, highway, and/or transit systems) that would impair the service quality and could reduce ridership of the HST system was considered a criterion for failing to satisfy the project purpose.
- Ridership/Revenue: Longer trip times and/or suboptimal operating characteristics (such as reduced frequencies to major markets, or inability to directly serve major markets) that would result in low ridership and revenue and impair the economic feasibility of the HST system were considered criteria for failing to satisfy the project purpose.

To simplify the evaluation of HST alignment and station options, the state was divided into five geographic regions or travel markets that are used throughout this Program EIR/EIS, as shown in Figure 2.1-1. Previous Commission and Authority studies, as described in Section 2.3.1 were reviewed and reevaluated to develop HST alignment and station options in the five regions. The screening evaluation of alignment and station options comprised the following key activities.

- Review of past alignment and station options identified within viable corridors in previous studies.
- Identification through the environmental scoping process of alignment and station options not previously evaluated.
- Evaluation of alignment and station options using standardized engineering, environmental, and financial criteria (described above) and evaluation methodologies at a consistent level of analysis.
- Identification of the ability of alignment and station options to meet defined objectives.

The results of five regional studies were documented in the *California High-Speed Train Screening Report* (California High Speed Rail Authority 2002). The technical data provided in the screening evaluation, combined with public and agency input, provided the Authority and the FRA with the necessary information to focus further studies for the Program EIR/EIS on those alignments, station locations, and HST systems that represent a reasonable range of practicable alternatives to meet the project purpose and attain several objectives established by the Authority. Those objectives include the following.

- Maximize ridership and revenue potential.
- Maximize connectivity and accessibility.
- Maximize compatibility with existing and planned development.
- Maximize avoidance of areas with geological and soils constraints.
- Maximize avoidance of areas with potential hazardous materials.
- Minimize operating and capital costs.
- Minimize impacts on natural resources.
- Minimize impacts on social and economic resources.
- Minimize impacts on cultural resources.

As part of the screening evaluation, the Authority directed specific alignment refinement studies to provide additional technical information for the screening decisions to be made in the northern and southern mountain passes. In some areas, the alignments considered in this screening process are largely constrained by land use issues and associated environmental resources. This was not necessarily the case in the northern mountain crossing (Diablo Mountain Range) between the Central Valley and the San Francisco Bay Area, and the southern mountain crossing (Tehachapi Mountain Range) between Los Angeles and Bakersfield, which are more constrained by physical features and associated environmental resources. While previous studies provided preliminary evaluations of these areas, screening decisions were complicated by the vast potential for variation in specific alignment (horizontal and vertical) and associated costs and impacts. Even in areas like the southern mountain crossing where the studies have focused on three primary corridors, differing alignment and grade options within any one corridor would present considerable differences in cost and impact.

Given the potential for a wide range of impacts in the mountain passes, the Authority completed a review of tunneling considerations, including a two-day technical conference and an alignment optimization and refinement study using the Quantm system[3] to assist in the screening review. The alignment refinement study also included further consideration of tunneling assumptions and parameters. The mountain range crossing for the proposed HST system would present difficult terrain and require extensive tunneling to accomplish the necessary traversing alignments. In the screening evaluation, alignment options were considered that could require a total of more than 80 mi (129 km) of twin-tube tunneling, including the potential for continuous tunnel segments of more than 30 mi (48 km). Crossing the Tehachapi Mountains between Los Angeles and Bakersfield could require 30 to 45 total mi (48 to 72 km) of tunneling in extremely challenging seismic and geologic conditions. These mountain crossings and the required tunneling would represent serious challenges for the construction of a proposed HST system. Relative certainty and confidence in the feasibility of the proposed tunneling and associated cost estimates were of critical importance to the screening evaluation.

To address the complex issues associated with the tunneling required for the statewide HST system, the Authority held a technical tunneling conference on December 3 and 4, 2001, in the Los Angeles area. The conference was attended by tunneling contractors, specialized tunnel engineers, geologists/geotechnical engineers, and representatives of the program management and regional study consultant teams, as well as Authority staff. The conference focused on gaining additional insights and input regarding feasibility, construction methods, and cost

[3] The Quantm system is a unique, state-of-the-art, automated route selection and optimization tool that performs automated alignment searches and corridor screening based on client- or user-specified geometry, constraints, and cost parameters. While Quantm has been widely used and proven in Australia, it has only recently become available for application in the United States. The Authority's work is the first application of this optimization system in North America.

assumptions associated with proposed tunneling for the HST system. The attendees generally concurred with the tunneling assumptions that had been previously applied for the screening evaluation. The attendees acknowledged the Authority's objective of minimizing the amount of tunneling required, particularly the use of long tunnels (more than 6 mi [10 km] long), due to cost, time of construction, and potential for delay. Tunnels more than 12 mi (19 km) long were considered infeasible for this project. The attendees also acknowledged the Authority's objective of crossing major fault zones at grade. The technical information produced by the tunneling conference is documented in the *Tunneling Issues Report* (California High Speed Rail Authority January 2004).

The alignment refinement/optimization study incorporated conclusions from the tunneling conference and further clarified and strengthened the technical basis for making screening-level decisions regarding potential HST corridors in the northern and southern mountain crossings. The study analyzed a broad range of horizontal and vertical alignment options using the Quantm system to provide more confidence that optimal alignments are being considered and more certainty concerning the cost estimates and potential impacts of each alignment option. The study focused on the following three objectives.

- Confirm the general corridors considered in the screening studies to date and/or identify any other corridors of equal or greater viability that may have been overlooked in previous studies.
- Refine the alignment options in each general corridor to identify the most viable options in terms of infrastructure requirements and impact avoidance/minimization.
- Test the sensitivity of the alignment options in each corridor based on key defining criteria such as vertical grade, alignment geometry, infrastructure (e.g., tunnel and structure) costs, and key environmental constraints.

Many individual alignment options were considered in each of the primary corridors in each mountain crossing, and each alignment was evaluated for maximum vertical grades of 2.5% and 3.5%. The Quantm system identified, located, and quantified the cost of approximately 12 million alignment options for each mountain crossing and provided a range of optimal alignments to choose from.

The alignment refinement studies provided a means to minimize tunneling and capital costs while avoiding or minimizing potential impacts on natural resources and other sensitive areas (e.g., natural communities and national forests). These sensitive areas were input to the Quantm system from the geographic information systems (GIS) environmental database and were included as constraints to the iterative alignment refinement process. The alignment refinement studies advanced the design of the HST options to support the screening evaluation in the mountain passes and are documented in the *Alignment Refinement/Optimization and Evaluation of the Quantm System* (California High Speed Rail Authority April 2002).

At the January 2002 Authority governing board meeting, board members reviewed the process and results and identified the alternatives recommended for analysis in this Program EIR/EIS. The board recommended several alignment and station options, and also recommended further study of steel-wheel-on-steel-rail as a technology option in the program-level environmental analysis. The board did not recommend further study of magnetic levitation as a proposed technology for the HST system. The FRA concurred with the recommendation for alternatives to be evaluated as part of the environmental review process.

2.3.3 Related Projects

For the past seven years, SCAG has been studying the feasibility of using maglev technology for regional high-speed transportation in the Los Angeles area. SCAG studies have focused on using a maglev system for commuter transportation and to connect regional airports in Southern California. SCAG envisions a 275-mile maglev system that would accommodate growing travel demand and relieve freeways. Current activities are focused on an initial line that would travel from West Los Angeles near to LAX to Ontario airport, paralleling the inland Los Angeles to San Diego route of the HST system. Other maglev lines would duplicate the Palmdale to Los Angeles, Los Angeles to San Diego, and Los Angeles to Orange County segments of the HST system. Figure 2.3-4 illustrates the overall maglev system. SCAG has completed the following planning studies:

- LAX to March Global Port, Riverside County
- LAX to Palmdale Regional Airport
- Los Angeles Union Passenger Terminal (LAUPT) to Anaheim, Orange County
- LAX to Irvine Transportation Center in South Orange County
- IOS - West Los Angeles to Ontario Airport

In addition, a Notice of Intent to prepare a Programmatic EIS has been issued by the FRA and the Nevada Department of Transportation for maglev service between Anaheim, California and Las Vegas, Nevada (a distance of approximately 270 miles).

As the federal lead agency for this Program EIR/EIS, the FRA will continue to coordinate Federal review of the HST system with the proposed Anaheim-Las Vegas and SCAG maglev concepts in Southern California. In addition, the Authority will coordinate with SCAG, the Nevada Department of Transportation, and other project sponsors during subsequent phases of HST system development and implementation particularly with regard to potential connections at HST stations as well as possible alignment and service plan conflicts or synergies.

2.4 NO PROJECT ALTERNATIVE

The No Project Alternative is the basis for comparison of the Modal and HST Alternatives. The No Project Alternative represents the state's transportation system (highway, air, and conventional rail) as it is currently and as it would be after implementation of programs or projects that are currently projected in regional transportation plans (RTPs), have identified funds for implementation, and are expected to be in place by 2020. This financially constrained level of infrastructure improvement (based on the expected federal, state, regional, and local funding) was analyzed in consideration of the considerable growth in population and transportation demand that is projected to occur by 2020. The No Project Alternative addresses the geographic area that serves the major destination markets for intercity travel and that would be served by the proposed HST Alternative. This area extends generally from the San Francisco Bay Area and Sacramento through the Central Valley to Los Angeles and San Diego. Figure 2.4-1 illustrates the existing intercity transportation infrastructure that currently serves these major travel markets.

The No Project Alternative satisfies the statutory requirements under CEQA and NEPA for an alternative that does not include any new action or project beyond what is already committed. The No Project Alternative defines the existing and future statewide intercity transportation system based on programmed and funded improvements through 2020, according to the following sources of information.

- State Transportation Implementation Program (STIP).
- RTPs, financially constrained projects for all modes of travel.

Figure 2.3-4
Southern California Association of Governments Regional Maglev System Plan

Figure 2.4-1
California Transportation System

- Airport plans.
- Intercity passenger rail plans.

The future improvements that would be part of the No Project Alternative are also included under both the Modal and HST Alternatives as part of the future 2020 baseline. No Project includes highway, aviation, and conventional rail elements, as discussed below.

2.4.1 Highway Element

The No Project highway system that currently serves the intercity travel market in the area proposed to be served by the HST Alternative includes the existing routes identified in Table 2.4-1, and illustrated in Figure 2.4-1. The No Project Alternative includes this existing highway system as well as funded and programmed improvements on the intercity highway network based on financially constrained RTPs developed by regional transportation planning agencies. Intercity highway improvements included as part of the No Project Alternative include infrastructure projects, as well as intelligent transportation system (ITS) and other potential system improvements programmed to be in operation by 2020. The improvements consist primarily of individual interchange improvements and roadway widening projects on limited segments of the highway network. As such, the improvements do not cumulatively add considerable line capacity to the highway system. The intercity highway improvements included as part of the No Project Alternative are identified by county in Appendix 2-A.

Table 2.4-1
Existing California Intercity Highway System

Interstate Highways	U.S. Highways	State Routes
Interstate 5 (I-5)	U.S. Highway 101 (US-101)	State Route 14 (SR-14)
Interstate 8 (I-8)		State Route 58 (SR-58)
Interstate 10 (I-10)		State Route 65 (SR-65)
Interstate 15 (I-15)		State Route 91 (SR-91)
Interstate 80 (I-80)		State Route 99 (SR-99)
Interstate 105 (I-105)		State Route 120 (SR-120)
Interstate 205 (I-205)		State Route 152 (SR-152)
Interstate 215 (I-215)		
Interstate 405 (I-405)		
Interstate 280 (I-280)		
Interstate 580 (I-580)		
Interstate 680 (I-680)		

2.4.2 Aviation Element

The air transportation system evaluated under the No Project Alternative consists of 18 airports that currently provide commercial service in the area proposed to be served by the HST Alternative (study area). The airports do not necessarily provide commercial service between the same intercity markets as the proposed HST system. These airports are illustrated in Figure 2.4-1 and listed below.

- Sonoma County Airport/Santa Rosa Airport (STS).
- Sacramento International Airport (SMF).

- Stockton Metropolitan Airport (SCK)[4].
- San Francisco International Airport (SFO).
- Oakland International Airport (OAK).
- Norman Y. Mineta San Jose International Airport (SJC).
- Modesto City-County-Harry Sham Field (MOD).
- Merced Municipal/Macready Field (MCE).
- Fresno Yosemite International Airport (FAT).
- Visalia Municipal Airport (VIS).
- Bakersfield Meadows Field Airport (BFL).
- Burbank-Glendale-Pasadena Airport (BUR).
- Los Angeles International Airport (LAX).
- Long Beach Daugherty Field (LGB).
- John Wayne International-Orange County Airport (SNA).
- Ontario International Airport (ONT).
- McClellan-Palomar Airport (CLQ) (Carlsbad).
- San Diego International Airport-Lindbergh Field (SAN).

Statewide, the airport development process is distinct from the highway and rail development processes and is not documented in local/regional transportation plans or in the STIP. In addition, because many airport improvements are funded with a combination of public and private funds, there is limited formal public documentation identifying committed projects that are likely to be operational by 2020.

For this analysis and to conceptualize a 2020 No Project airport system, criteria for airport development were developed to review proposed projects and determine their likelihood for implementation and operation by the year 2020. Proposed airport improvements were evaluated based on a review of available documentation, interviews with airport planning and development professionals, local area knowledge, and public agency input. An airport improvement is deemed likely to be implemented and operational by 2020 if the improvement meets the following criteria.

- Has been identified in an approved or under-development airport master planning program, environmental document, regional aviation system planning document, or capital improvement program.
- Is reasonably practical to place into operation by 2020.

By applying this approach, the airport improvements likely to be funded, programmed, and operational by 2020 are summarized in Table 2.4-2.

Only a portion of the programmed, funded, and potentially operational improvements for 2020 are related to California intercity trips entirely made within the state. The projected aviation improvements were adjusted to represent only the intra-California proportional share, based on the Passenger Survey for California Market Demand in the *Official Airline Guide [OAG]* (Parsons Brinckerhoff 2002) as summarized in Table 2.4-3. The addition of this proportion of improvements to the existing 2001 airport

[4] America West stopped commercial services in September 2003. San Joaquin County is actively seeking new commercial carriers.

facilities and aviation system is represented in the No Project Alternative. Appendix 2-B provides a detailed description of the aviation element of the No Project Alternative.

Table 2.4-2
Assumed Total Programmed, Funded, and Operational Airport Improvements[a]

Airport	Passenger Terminal Size (square feet)	Runways	Gates	Primary Access Lanes	Parking Spaces (On-/Off-Site)
Bay Area					
Oakland (OAK)	320,000	0	12	2[5]	10,000
San Jose (SJC)	500,000	0	17	2	6,400
Northern Central Valley					
Sacramento (SMF)	250,000	0	14	1	5,000
Southern Central Valley					
Fresno (FAT)	188,000	0	5	1	1,800
Los Angeles					
Ontario (ONT)	800,000	0	24	4	5,000
San Diego					
San Diego (SAN)	200,000	0	8	2	3,000
Statewide Total[b]	**2,258,000**	**0**	**80**	**12**	**31,200**

[a] Total improvements assumed to be programmed, funded, and operational by 2020.

[b] The City and County of San Francisco and the FAA have commenced preparation of an EIR/EIS for a runway expansion/reconfiguration at SFO that may occur before 2020. It is not assumed as part of the No Project improvements since it does not meet the criteria as established.

Sources: Master planning and environmental documents, regional aviation system planning documents, and interviews with local area airport staff and airport planners (see Chapter 12).

Table 2.4-3
Assumed Programmed, Funded, and Operational Improvements Adjusted for Trips Inside California*

Airport	Passenger Terminal Size (square feet)	Runways	Gates	Highway Lanes	Parking Spaces (On-/Off-Site)
Bay Area					
Oakland (OAK)	192,000	0	7	1	6,010
San Jose (SJC)	245,000	0	8	1	3,140
Northern Central Valley					
Sacramento (SMF)	102,500	0	6	0	2,050
Southern Central Valley					
Fresno (FAT)	112,800	0	3	1	1,080
Los Angeles					
Ontario (ONT)	512,000	0	15	1	3,200

[5] Includes the Oakland Airport Connector project, which is currently under construction for completion in spring 2005. The connector is a 3 (approx.)-mile people mover, operating on exclusive guideway connecting the Oakland International Airport to the BART Coliseum Station.

Airport	Passenger Terminal Size (square feet)	Runways	Gates	Highway Lanes	Parking Spaces (On-/Off-Site)
San Diego					
San Diego (SAN)	54,000	0	2	1	810
Statewide Total	**1,218,300**	**0**	**41**	**5**	**16,290**

* Adjusted to represent the proportional share of improvements by 2020 for intercity California trips only. Assumed intercity California trips are Oakland 60%, San Jose 49%, Fresno 60%, Sacramento 41%, Ontario 64%, and San Diego 27%.

Source: *Official Airline Guide (OAG) Passenger Survey for California Market Demand*, August 2002. Parsons Brinckerhoff, November 2002.

2.4.3 Conventional Passenger Rail Element

Existing intercity passenger rail service is provided on four principal corridors covering more than 1,300 route mi (2,092 route km) and spanning almost the entire state. The No Project passenger rail network is composed of three of these corridors (capitol corridor, Pacific Surfliner corridor, and San Joaquin corridor) as illustrated in Figure 2.4-1 and described below. The fourth corridor, the coastal corridor, is not included as part of the No Project Alternative because it does not serve the major intercity market (Los Angeles to San Francisco) with competitive frequency or travel time. It primarily serves the intermediate markets (coastal cities).

Within these corridors, the intercity passenger service currently shares track with freight and/or commuter services. The primary portions of these corridors serve the same intercity markets as the proposed HST Alternative. All the intercity passenger rail system improvements identified in the STIP and the Caltrans California Intercity Rail Capital Program for implementation prior to 2020 are included in the No Project Alternative and are identified in Appendix 2-C. To increase levels of passenger service, the improvements consist of additional track capacity, maintenance and storage facilities, grade-crossing improvements, track and signal improvements, and expanded or upgraded passenger stations.

2.5 MODAL ALTERNATIVE

Four options exist for intercity travel between the major urban areas of California.

- Vehicles on the interstate highway system and state highways.
- Commercial airlines serving airports.
- Conventional passenger trains (Amtrak) on freight and/or commuter rail tracks.
- Long-distance commercial bus transit.

The Authority and the FRA developed a modal alternative that focuses on intercity modes of transportation other than high-speed rail. Air and highway travel are clearly the predominant modes for intercity trips, in particular intercity trips longer than 150 mi (241 km). The Modal Alternative consists of hypothetical future expansions of highways and airports serving the same geographic areas as the proposed HST system. For consistency, the Modal Alternative was developed to provide equivalent capacity to serve the representative demand for intercity travel that was derived from the higher ridership forecasts from the sensitivity analysis completed for the HST system operating in 2020, as described in Chapter 1. As described above in Section 2.3-2, the representative demand is based on the independent ridership and revenue forecasts prepared for the Authority by Charles River Associates (2000).

The 2020 ridership forecasts used in the Business Plan varied between 42 million and 68 million passengers (10 million riders of which are long-distance commuters), depending on key assumptions regarding future travel cost and congestion levels as well as higher growth rates for intercity trips. The purpose of and need for this project is to meet part of California's future intercity travel demand in 2020 and beyond. Therefore, the high end of the forecast range (68 million annual passengers) is assumed as a basis for defining the level of improvement for the HST Alternative as well as the Modal Alternative. The representative demand comprises approximately 58 million intercity trips (the high-end forecast) and 10 million long-distance commute trips, totaling 68 million annual trips. The 68 million annual trips primarily represent trips that would be diverted from another mode (i.e., auto, rail, or plane) to an HST system, if it were available.

The representative intercity 2020 travel *demand*, rather than the HST *capacity*, is used as the basis for defining the hypothetical modal improvements because it is consistent with the project purpose and need. Because the HST Alternative has such a high capacity potential, using the HST capacity as the basis to define modal alternatives would overstate the amount of improvement needed for 2020 and the foreseeable future. While the HST system would have the capacity to carry many more passengers than those accounted for in the representative demand (e.g., the Tokaido Line in Japan carries more than 130 million passengers per year), the system alternatives are based on the 2020 forecast because it provides a reasonable estimate of the number of passengers that might be expected to be carried on the high-speed rail infrastructure in the foreseeable future. Developing a modal alternative that provided a maximum level of capacity similar to the HST system would result in extensive infrastructure improvements that would be considered unreasonable. Defining a modal alternative based on a level of capital expenditure similar to that of the HST rather than based on representative demand would result in a level of improvement that would not necessarily relate to the forecasted demand.

In developing the Modal Alternative to analyze in this Program EIR/EIS, analyses were conducted to identify the most reasonable, feasible, and practicable modal improvements that could best meet the project purpose and need and objectives. The analyses also assessed the appropriateness of accommodating the representative demand within a single mode of transportation. The improvements considered for each mode are capacity-oriented (e.g., additional traffic lanes for highways with associated interchange reconfiguration and ramp improvements; additional gates and runways for airports with associated taxiways, parking, and passenger terminal facilities), and this corresponds to the representative demand for a proposed HST system.

2.5.1 Modal Alternatives Considered and Rejected

A. HIGHWAY SYSTEM IMPROVEMENTS ONLY

In the development of the Modal Alternative, an analysis was conducted to assess the appropriateness of accommodating the representative demand solely within the highway mode of intercity transportation. The analysis showed that it would not be practical or feasible for highway improvements alone to serve the range of intercity trip lengths. The analysis also showed that highway improvements alone would not meet the purpose and need and objectives of the proposed HST system in terms of reliability, safety, and preservation of the state's natural resources.

Overall, the highway improvement options represent a total of 3,300 lane mi (5,311 km) of new highway construction. In the central portion of the study area, including the Tehachapi Mountain crossing, as many as six additional highway lanes (expanding I-5 and State Route 14 [SR-14]/SR-58) would be necessary to serve the forecasted demand. This level of infrastructure improvement would be difficult to meet because of the terrain and right-of-way constraints.

In addition, increasing the highway capacity through the central portions of the study area would not considerably reduce highway travel times for longer distance trips (e.g., Los Angeles to San Francisco). Trip distance would still be a determining factor in the modal choice between air and

automobile travel, and it is unlikely that the majority of the longer distance trips would be by auto. Feasibility concerns are also raised by the considerable capacity improvements identified for existing and planned highway facilities in congested urban regions of the study area that have used all available rights-of-way. It is generally not feasible to add considerable capacity to the existing facilities or create new corridors in these areas because high costs and impacts would be incurred in acquiring and preparing new rights-of-way.

There is also concern about the viability of relying solely on expanded highways for intercity trips through heavily congested urban areas, because in many cases the existing urban freeways are so congested that any additional capacity would serve to simply meet forecasted urban/commute traffic demand. Adding lanes to these facilities may have no more effect than to lessen the existing peak congestion period or allow current demand to use the facility during peak usage periods. This would leave no measurable increase in capacity to serve the intercity travel demand. The highway improvements associated with this scenario are documented in Appendix 2-D.

B. AVIATION IMPROVEMENTS ONLY

In the development of the Modal Alternative, an analysis was conducted to assess the appropriateness of accommodating the representative demand solely within the aviation mode of intercity transportation. The analysis showed that it is not practical or feasible to assume that improvements to the aviation system alone could accommodate all of the representative intercity travel demand.

Air travel would not be competitive for trips less than 150 mi (240 km). The automobile is the most competitive travel mode for these trips in terms of convenience, cost, and journey time. For a typical 150-mi (240-km) trip within the study area, it is estimated that the total journey time by private auto would be about 3 hours (hrs) or less (assuming an average speed of 50 mph, or 80 kph) compared to about 3 to 4 hrs by air (assuming 1 to 1.5 hrs for access/egress to and from the airport and point of origin, 1 hr pre-board check-in arrival time, 30 minutes (min) deplaning/baggage claim time, and 30-min to 1-hr flight time). In addition, trips by private auto are not limited to scheduled arrival and departure times, and they are less affected by weather delays.

The magnitude of aviation improvements required to accommodate the representative intercity demand is clearly not practical considering current airport utilization levels along with the land use, environmental, and other capacity constraints that limit airport expansion projects. The aviation improvements associated with this scenario are documented in Appendix 2-E.

C. CONVENTIONAL PASSENGER RAIL IMPROVEMENTS ONLY

Consideration was given to improving the conventional passenger rail system to accommodate all or part of the representative demand in the same geographic markets as the proposed HST Alternative. Conventional intercity rail was not given further consideration as a stand-alone alternative or as part of the development of the Modal Alternative because it would not provide or assist in providing a competitive option to satisfy much of the representative intercity demand that the Modal Alternative is designed to capture.

It is estimated that conventional intercity rail would serve only 1% of the representative demand because it attracts trips that are less sensitive to travel time and more sensitive to cost, and require shorter travel distances (based on the *Independent Ridership and Passenger Revenue Projections for High-Speed Rail Alternatives in California, Draft Final Report* [Charles River Associates 2000]). Because conventional rail shares track with freight trains that can interfere with passenger train schedules, and because existing tracks have curves and grade changes that are designed for slower speeds, the travel times for conventional rail are not competitive with the other modes of intercity travel. For example, under existing conditions the total travel time on Amtrak's San Joaquin service