6 PROJECT COSTS AND OPERATIONS

6.1 Introduction

This chapter discusses the estimated costs for building, operating, and maintaining the San Francisco to San Jose Project Section (Project Section or project) of the California High-Speed Rail (HSR) System, based on a preliminary level of design used in preparing this Draft Environmental Impact Report (EIR)/Environmental Impact Statement (EIS). Additional details are provided in Volume 2 of this document and include:

- Appendix 2-C, Operations and Service Plan, provides background information on the intended service and operations of the HSR system to provide sufficient detail for the environmental assessment of proposed HSR operations.
- Appendix 6-A, San Francisco to San Jose Project Section: PEPD Record Set Capital Cost Estimate Report, presents the capital cost estimating methodology and summary of capital cost estimates. As stated in this report, the construction cost estimates were developed for each alternative based on the preliminary engineering for project definition design plans, which are the same plans used in this Draft EIR/EIS.
- Appendix 6-B, High-Speed Rail Operating and Maintenance Cost for Use in EIR/EIS Project-Level Analysis, summarizes the assumptions used to estimate full system HSR operations and maintenance (O&M) costs.

The following sections discuss capital costs and O&M costs.

6.2 Capital Costs

Capital costs represent the total cost associated with the design, management, land acquisition, and construction of the HSR system. To evaluate and compare project construction costs, the California High-Speed Rail Authority (Authority) and the Federal Railroad Administration (FRA) have developed 10 standardized capital cost (SCC) categories. The following list briefly describes each category:

- **10 Track structures and track**—Includes elevated structures (bridges and viaducts), embankments and open cuts, retaining-wall systems, tunnels, culverts, and drainage, track (ballasted and non-ballasted), and special trackwork
- **20 Stations, terminals, intermodal**—Includes rough grading, excavation, station structures, enclosures, finishes, and equipment; mechanical and electrical components, including heating, ventilation, and air conditioning, station power, lighting, public address/customer information systems; station site elements, such as pedestrian/bike access and accommodation; landscaping for parking lots; automobile, bus, and van access ways, including roads; and safety systems, such as fire detection and prevention, security surveillance, access control, and life safety systems
- **30 Support facilities: yards, shops, administration buildings**—Includes rolling stock service, inspection, and storage; heavy maintenance and overhaul facilities; and storage equipment, associated yard tracks, and electrification; this category also includes maintenance of way facilities
- **40 Sitework, right-of-way, land, existing improvements**—Includes cost of demolition, hazardous materials removals, environmental mitigation, utility relocations, noise mitigation, intrusion protection, grade separations, roadway improvements, acquisition of real estate, and temporary facilities and other indirect costs
- **50 Communications and signaling**—Includes all costs associated with implementing automatic train control systems, including positive train control and intrusion detection where applicable

- **60 Electric traction**—Includes costs of traction power supply system, including supply, paralleling, and switching substations, as well as connections to the power utilities and the traction power distribution system in the form of overhead contact system
- **70 Vehicles**—Includes costs for acquisition of the trainsets (design, prototype unit, and production and delivery of trainsets to the project site on an annual basis); acquisition of trainsets is considered a systemwide cost and is not included as part of the cost of individual project alternatives
- **80 Professional services**—Includes all professional, technical, and managerial services related to the design and construction of track and systems (SCC 10–60) during the preliminary engineering, final design, and construction phases of the project/program (as applicable)
- **90 Unallocated contingency**—Includes program reserves
- **100 Finance charges**—Includes finance charges expected to be paid by the project/program/sponsor/grantee prior to either the completion of the project or the fulfillment of the FRA funding commitment, whichever occurs later in time (not included in the estimate)

6.2.1 High-Speed Rail Project Alternatives

The Authority developed the conceptual level cost estimates prepared for each of the project alternatives using recent bid data from large transportation projects in the western United States and by developing specific, bottom-up unit pricing to reflect common HSR elements and construction methods with an adjustment for regional labor and material costs in the Project Section. The engineers estimated all material quantities for the project based on preliminary design. The Authority generally defines this level of design as encompassing at-grade, below-grade, or elevated profiles; structure types; placement of retaining walls; and amounts of earth fill. Stations are still conceptual, but roadway and utility relocations have been identified and any necessary power substations have been sized and located.

The capital cost estimates include the total labor and materials to build the Project Section, including the track structures, stations, support facilities, communications and signaling, electric traction and any necessary utility relocations, upgrades, and roadway modifications. The capital cost estimates reflect all related project improvements but do not include costs associated with the No Project Alternative.

The SCC 40 estimated costs include right-of-way, property acquisition, and environmental mitigation. Right-of-way costs were estimated based on the preliminary design and are documented in Volume 2, Appendix 6-A. However, as the design of the project is refined, the right-of-way limits would be reassessed to reflect refined property acquisition needs. As a result, property acquisition costs are estimated in broad categories (i.e., urban, suburban, and rural and by land use density level) and based on local land values rather than on a parcel-by-parcel assessment at this phase of project development. Right-of-way costs include the estimated cost to acquire properties needed for the future right-of-way and include costs associated with temporary easements for construction that are assumed to be part of the construction contractor's responsibility to negotiate for use. Environmental mitigation costs are estimated at approximately 3 percent of the capital cost, given potential project impacts and typical mitigation costs in the region (Volume 2, Appendix 6-A).

The capital cost estimates for the project alternatives do not include the cost of acquiring HSR vehicles (SCC 70) because the vehicles would be part of the statewide system and are not associated with constructing individual project sections. Consistent with the Authority's *2018 Business Plan: Connecting California, Expanding Economy, Transforming Travel* (2018 Business Plan) (Authority 2018a), the Authority determined the cost of vehicles by using publicly available data regarding recent sales of comparable equipment to other HSR projects around the world. Additional costs are included for adaptation of existing trainset designs to meet U.S. safety

regulations and to comply with "Buy America" requirements.[1] The systemwide cost of vehicle procurement is divided into two milestones: (1) the Silicon Valley to Central Valley Line (Valley-to-Valley) from San Francisco to Bakersfield, and (2) Phase 1 Service from San Francisco to Anaheim in the south. Vehicle procurement cost is estimated at $4.5 billion in 2017 dollars for the complete Phase 1 system.

Professional services (SCC 80) represent the cost of engineering; project construction and management; contract administration; permits and fees; and training, start-up, and testing. These costs are estimated at 15.5 percent of the construction costs divided between preliminary engineering (2 percent), program management (3 percent), final design (6 percent), construction management (4 percent), and agency costs (0.5 percent). In addition, an allowance for system start-up and pre-revenue testing is added to the professional services cost category in the amount of 6 percent of the train controls, communications, and electrification construction costs.

At this early stage of design, the capital cost estimates include contingencies to account for changes in material costs and changes during project design. Currently, the Authority assumes allocated contingencies (i.e., money reserves assigned to each cost category to cover risks associated with design uncertainty) to be between 10 and 25 percent of the estimated construction and right-of-way acquisition costs. Unallocated contingency (SCC 90) (i.e., project reserves intended to cover unknown risks) is estimated to be 5 percent of construction and right-of-way acquisition costs (see Volume 2, Appendix 6-A).

Finance charges, or the cost of borrowing money, would be included in SCC 100, but have not been estimated at this phase of project development. These costs will be developed prior to the start of construction after the Authority's construction bonds are sold.

Table 6-1 shows the capital cost estimates for both project alternatives from the 4th and King Street Station in San Francisco to West Alma Avenue in San Jose. The alignments would be approximately 49 miles and are estimated to have construction costs from approximately $4,253 million to $6,858 million (2018$). The primary differences between the two project alternatives are the location of the light maintenance facility (LMF) in Brisbane (either east or west of the existing Caltrain tracks), the additional passing track included under Alternative B, and the alignment through downtown San Jose (blended at grade, or dedicated viaduct beginning at either Interstate 880 or Scott Boulevard). Refer to Chapter 2, Alternatives, for additional information.

[1] Buy America requirements apply to mass transit projects and give preference to the use of domestically produced materials on any procurements funded at least in part by federal funds. Administered by the Federal Transit Administration, the requirements are described at 49 Code of Federal Regulations Part 661.

Table 6-1 Capital Cost of the High-Speed Rail Project Alternatives (2018$, in millions)

Standard Cost Categories[1]	Alternative A	Alternative B (Viaduct to I-880)	Alternative B (Viaduct to Scott Boulevard)
10 Track structures and track	$470	$1,440	$1,856
20 Stations, terminals, intermodal	$346	$542	$542
30 Support facilities: yards, shops, administration buildings	$685	$421	$421
40 Sitework, right-of-way, land, existing improvements	$2,029	$2,603	$2,808
50 Communications and signaling	$137	$140	$140
60 Electric traction	$136	$162	$162
70 Vehicles	Considered a systemwide cost and not included as part of the project alternatives within individual project sections.		
80 Professional services (categories 10–60)	$289	$487	$569
90 Unallocated contingency[1]	$162	$333	$360
100 Finance charges	Estimate to be developed prior to project construction		
Total capital costs[2]	$4,253	$6,128	$6,858

Source: Volume 2, Appendix 6-A
I- = Interstate; SCC = standard capital costs
Totals may not add up due to rounding.
[1] All cost categories include allocated contingencies. SCC category 90 Unallocated contingency, is only unallocated monies.
[2] Capital cost estimates exclusive of all costs for SCC categories 70 Vehicles and 100 Finance charges.

6.2.2 Light Maintenance Facilities

O&M of the HSR system would require the placement of maintenance facilities along the alignment. For systemwide operations, terminal station locations would be supported by an LMF for supplying inspected and serviced trainsets at the start of operations each day.

The Authority based the planning for these facilities on the current implementation phases of the HSR project. The need for developing LMF sites depends upon the service plans and phasing adopted by the Authority. Terminal station locations would evolve as the system matures through the operating service segments:

- **Silicon Valley to Central Valley Line (Valley-to-Valley)**—San Francisco to Bakersfield
- **Phase 1 Service**—San Francisco to Anaheim

The San Francisco to San Jose Project Section would include construction of an LMF in Brisbane, and the costs are included in Table 6-1. The LMF would be sized to support specific maintenance activities. These activities would include cleaning and servicing between runs, pre-departure inspections and testing, monthly inspections and maintenance, and, in some instances, train washing and wheel truing.

Figures 2-32 and 2-43 in Chapter 2 show the two potential locations for the LMF. The two sites for the LMF in the Project Section under consideration are:

- **East Brisbane LMF**—This LMF would be built in Brisbane under Alternative A just south of the San Francisco Caltrain tunnels on approximately 100 acres east of the Caltrain corridor.
- **West Brisbane LMF**—This LMF would be built in Brisbane under Alternative B just south of the San Francisco Caltrain tunnels on approximately 110 acres west of the Caltrain corridor.

The LMF in Brisbane would include a maintenance yard with yard tracks adjacent and parallel to a maintenance building containing shop tracks with interior access and inspection pits for underside and truck inspections. The LMF would provide storage capacity for trains and accommodate light maintenance activities, including daily inspections, pre-departure cleaning, testing, and servicing between runs; monthly inspections; quarterly inspections; train washing; and wheel truing. Direct HSR mainline track access would be along double-ended yard leads that enable north and south movements.

6.3 Operations and Maintenance Costs

The estimated long-term O&M costs include both train operations and infrastructure maintenance. Operations costs involve labor, electrical power, and other aspects required to keep the HSR system in service. Maintenance costs include routine servicing of vehicles and maintenance of the tracks, signals, communications, and other systems needed to keep the system safe and reliable.

Chapter 2 describes O&M activities in detail. The Phase 1 system would operate the HSR trains on approximately 520 miles of track by 2040. Phase 1 would include 13 HSR stations; San Francisco, Millbrae, and San Jose are the station cities in the Project Section. Additional facilities would be required for overnight storage, inspection, and routine maintenance of more than 78 trainsets, each nearly 660 feet long. A heavy maintenance facility (HMF), serving the entire HSR system, would be located between Merced and Bakersfield. The HMF would store and maintain some of the trainsets. Maintenance of way facilities would also be required approximately every 100 miles along the railroad right-of-way.

The estimated long-term O&M costs include both train operations and track and systems maintenance. Operational costs consist of labor costs, electrical power, and other factors required to keep the HSR system in service, whereas maintenance costs include routine servicing of vehicles, maintenance of the tracks, signals, communications, and other systems needed to keep the system safe and reliable. O&M costs are based on daily rail miles, operational speeds, HSR station configurations, maintenance and storage facilities, and operating frequencies in accordance with the 2018 Business Plan (Authority 2018a).

6.3.1 Operating Speeds

The HSR system would operate at speeds of up to 110 miles per hour throughout the Project Section. These design speeds would be applicable even in the southernmost portions of the Project Section, where Alternative B would be on fully grade-separated, dedicated HSR track near the San Jose Diridon Station.

6.3.2 Development of Operation and Maintenance Costs

An important goal of the Authority's business plan is to achieve a balance between O&M costs and projected farebox revenues as proof of the requirements mandated by The Safe, Reliable, High-Speed Passenger Train Bond Act for the 21st Century (Proposition or Prop 1A), adopted by California voters in November 2008. The Authority has continued to refine its O&M cost model to reflect a more accurate cost basis for the program's current level of detail.

O&M cost estimates include operational activities needed to serve and carry the forecast train service for Phase 1 in 2040 for the medium ridership scenarios described in Section 2.7.1, Travel Demand and Ridership Forecasts; the maintenance necessary to keep the system in a state of good repair; and the administrative activities and costs (Volume 2, Appendix 6-B). The estimated O&M costs in this chapter are based on the Authority's 2018 Business Plan.[2] The current HSR O&M model is based on cost categories defined in the U.S. Department of Transportation (USDOT) *High-Speed Intercity Passenger Rail Program (HSIPR) Best Practices: Operating Costs*

[2] The Authority released a Draft 2020 Business Plan in February 2020 for public review and comment. The plan's final adoption is intended at the June 2020 Board meeting for submittal to the California Legislature by July 1, 2020. The Draft 2020 Business Plan reports slightly higher O&M costs than the 2018 Business Plan, but it continues to project that the total revenues would exceed the O&M costs for each scenario evaluated (Authority 2020).

Estimation (USDOT 2011), where applicable. The report defines the general parameters for estimating the preliminary, intermediate, final, and commercial closeout stages of a program. No program falls neatly into all of these parameters, and there is usually some overlap between the stages. In this context, large parts of the Authority's O&M cost model fall into the intermediate stage, while other parts might be classified as preliminary or final stage (USDOT 2011).

The O&M cost of HSR equipment includes the cost of: (1) crew, administration, and supplies to operate and dispatch the HSR services; (2) electric power for traction, onboard systems, stations, and maintenance/other facilities; and (3) cleaning, inspection, maintenance, and overhauling of the trainsets.

Maintenance of infrastructure covers the expense of patrolling, inspecting, and maintaining the right-of-way, fencing, structures, bridges, tunnels, roadbed, track, signaling, overhead contact systems, substations and similar electrical facilities, communications, intrusion detection, and facilities.

Station O&M costs include the day-to-day operations of the station, ticket sales and machine maintenance, public safety, passenger handling, and cleaning. Insurance, administration, and contingency costs are also included in O&M costs. For a more detailed discussion of how O&M costs were derived, please refer to Volume 2, Appendix 6-B. Station staffing assumes the following job categories:

- Station manager
- Ticket clerk/customer service representative
- Sworn and unsworn security
- Station and train cleaning
- Frontline supervisors

The O&M cost model includes the following categories of O&M costs:

- Train operations
- Dispatching
- Maintenance of equipment
- Maintenance of infrastructure
- Station and train cleaning
- Police and security positions
- Commercial costs and functions
- General administrative activities
- Insurance
- Unallocated contingency

The 2018 Business Plan updated the O&M cost model with the latest available information on socioeconomic forecasts, transit network plans, auto travel time, auto operating costs, parking costs, and operational planning (reflecting updated trip times, station assumptions, and frequency and patterns of service). It also included an enhanced risk analysis relevant to the ridership and farebox revenue forecasts based on feedback received on the Authority's *Connecting and Transforming California: 2016 Business Plan* forecasts (Authority 2016).

Table 6-2 shows revenue and O&M costs at the key implementation phases for the Medium Scenario[3] from the 2018 Business Plan. These forecasts demonstrate that the farebox revenue is expected to cover systemwide O&M costs. For example, in 2029 revenues would exceed annual O&M costs by $584 million, while by 2040 revenues would exceed annual O&M costs by $1,427 million (2017$).

[3] The Authority's 2018 O&M cost model produced medium and high forecasts to represent a range of future system operating costs. For additional detail, please refer to Appendix 6-B in Volume 2 of this Draft EIR/EIS and to the Authority's *2018 Business Plan: Technical Supporting Document: Operations and Maintenance Cost Model Documentation* (Authority 2018b).

Table 6-2 Medium Scenario Revenue and Annual Operations and Maintenance Costs

	Valley-to-Valley 2029	Phase 1 System 2029	2040
Farebox revenue ($2017 millions)	$334	$1,380	$2,374
O&M costs ($2017 millions)	$255	$796	$947

Source: Authority 2018a
O&M = operations and maintenance