2 ALTERNATIVES

2.1 Introduction

Since publication of the Draft Environmental Impact Report/Environmental Impact Statement (EIR/EIS), the following substantive changes have been made to this chapter:

- The chapter describes modifications made to the project design: (1) in response to comments on the Draft EIR/EIS from agencies, stakeholders and the general public; (2) to further minimize environmental impacts or the necessary footprint area; and (3) to further improve safety and reduce costs.
- Text was added to Section 2.8.3 to clarify the assumed sources for construction water.
- Text describing the Authority's Project-Level Alternatives Development Process that was incorrectly placed under Section 2.3.10.3 (Maintenance of Infrastructure Sidings) has been moved to Section 2.3.11 (High-Speed Rail Project-Level Alternatives Development Process).

This chapter describes the Bakersfield to Palmdale Project Section (B-P) High-Speed Rail (HSR) Build Alternatives that the California High-Speed Rail Authority (Authority) is considering in this EIR/EIS. The chapter addresses the following topics:

- The background and development of the California HSR System and the Bakersfield to Palmdale Project Section, including previous studies and alternatives screening
- The individual components of the B-P Build Alternatives
- Potential alternatives considered during the alternatives screening process
- The No Project Alternative and the B-P Build Alternatives, including the California Environmental Quality Act (CEQA) Proposed Project
- Travel demand and ridership forecasts
- An operations and service plan
- Additional HSR development considerations
- Construction plan and phased implementation strategy
- Permits and approvals required

The following appendices provide more detailed information on Bakersfield to Palmdale Project Section characteristics:

- Appendix 2-A, Road Crossings, Closures, and Detours
- Appendix 2-B, Railroad Crossings
- Appendix 2-C, Operations and Service Plan
- Appendix 2-D, Applicable Design Standards
- Appendix 2-E, Impact Avoidance and Minimization Features
- Appendix 2-F, Summary of Requirements for Maintenance Facilities
- Appendix 2-G, Emergency and Safety Plans
- Appendix 2-H, Detailed Plan Compatibility Analysis
- Appendix 2-I, Desert Renewable Energy Conservation Plan (DRECP) Applicability Analysis

The Authority and the Federal Railroad Administration (FRA) sought to identify reasonable and feasible B-P Build Alternatives that would meet the Purpose and Need for the project. Additionally, the alternatives development process identified those alternatives where environmental constraints or engineering challenges might justify dropping the alternatives from further analysis while retaining those alternatives designed to avoid and minimize impacts on environmental and community resources. The process also provided comparative information and data highlighting similarities and differences between alternatives by using applicable state and federal standards, environmental impact criteria, design criteria, and construction/operation factors. Since 2005, the Authority has continued to work with community and agency stakeholders to vet the conceptual alternatives and to refine the project design, gathering and evaluating additional environmental information and comparing the alternatives.

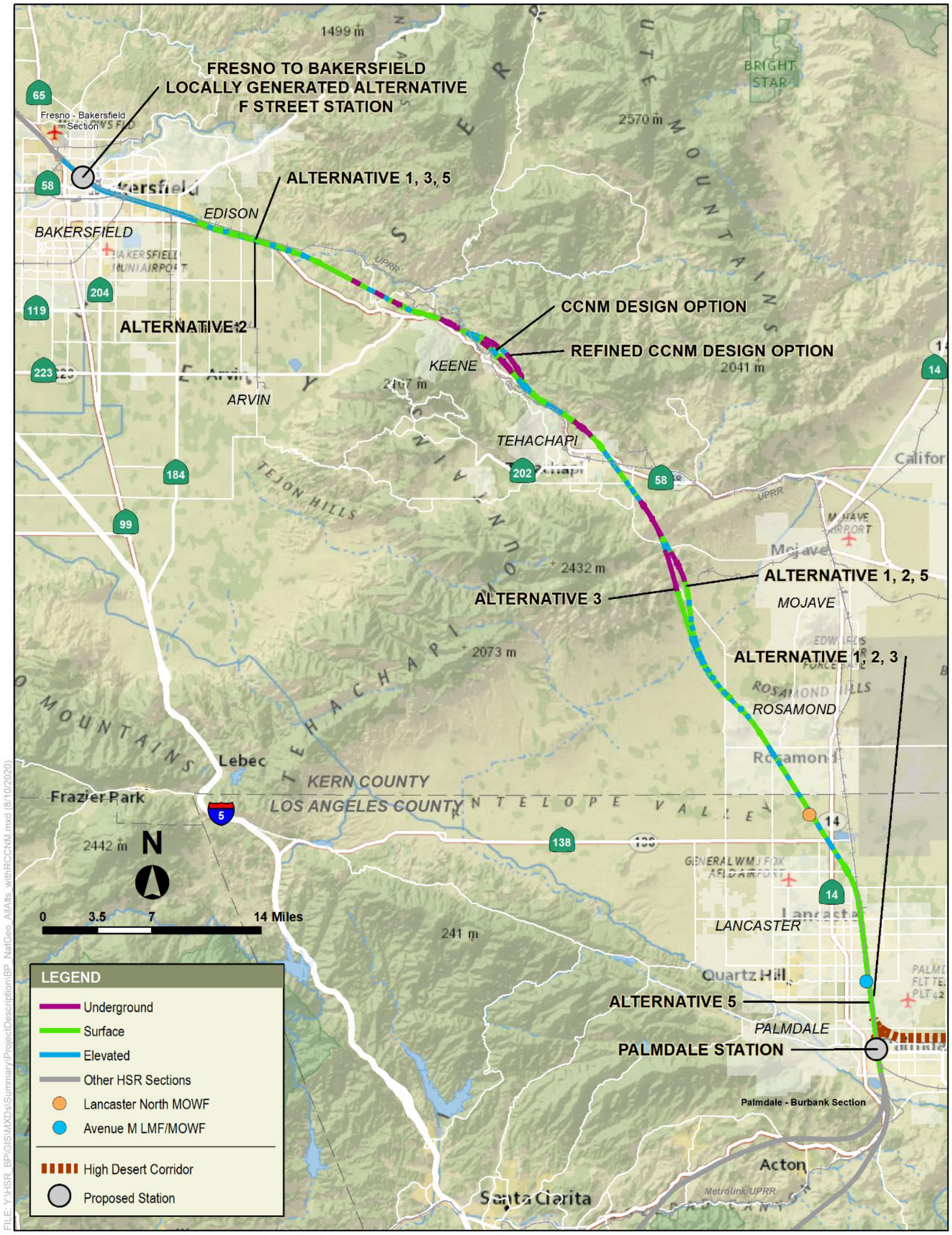
The Build Alternatives development process for the Bakersfield to Palmdale Project Section had to take into consideration the significant engineering challenges associated with meeting the HSR performance and safety criteria for a route that travels through mountainous topography and crosses major active fault zones. Due to the challenges related to topography and elevation change through the Tehachapi Mountains segment of the Bakersfield to Palmdale Project Section, high bridge structures and tunnels would be used to maintain the maximum 2.8 percent grade for high-speed train operations. The Bakersfield to Palmdale Project Section is located in one of the most seismically active areas in the country, where geology-related risks and establishing the horizontal alignment and vertical profile of the alignment alternatives are important considerations.

All of the B-P Build Alternatives this chapter discusses are variations of the preferred alignment selected by the Authority and FRA at the conclusion of the Tier 1 EIR/EIS (Authority and FRA 2005) processes for the HSR project. Building on the earlier analysis, the Authority in September 2010 issued the *Preliminary Alternatives Analysis Report, Bakersfield to Palmdale Section High-Speed Train Project EIR/EIS* (PAA) for the Bakersfield to Palmdale Project Section. This document introduced an initial range of Build Alternatives based on the HSR corridor selected in 2005 and the Programmatic EIR/EIS for the statewide HSR system (three Edison, four Tehachapi, and two Antelope Valley Subsection alternatives). In February 2012, the Authority released the *Supplemental Alternatives Analysis Report, Bakersfield to Palmdale Section High-Speed Train Project EIR/EIS* (2012 Supplemental Alternatives Analysis [SAA]), which presented a refined range of alternatives for the Bakersfield to Palmdale Project Section based on new information obtained since the previous study (four Edison, three Tehachapi, and four Antelope Valley Subsection alternatives). Since the 2012 SAA, the Authority has continued to refine the alternatives in response to input from stakeholders, as well as improving the degree to which the alternatives meet the Authority's objectives and the Purpose and Need for the project. This additional study effort led to the preparation of an Alternatives Screening Memorandum (ASM) (Authority 2016a).

The first objective of the ASM was to refine alternatives from the 2012 SAA based on new information obtained since the previous studies and compare them to the previous alternatives. This comparison was performed for each subsection alternative in a process similar to that used in the previous SAAs. The second objective of the ASM was to combine the recommended alternatives from each subsection into complete end-to-end alignments, resulting in eight alternatives.

Building on the ASM recommendations, the *Supplemental Alternatives Analysis Report, Bakersfield to Palmdale Section High-Speed Rail Project EIR/EIS* (2016 SAA) (Authority 2016e) continued the evaluation process and recommended the four B-P Build Alternatives analyzed in this EIR/EIS. This EIR/EIS also analyzes a design option to minimize impacts to the Nuestra Señora Reina de La Paz/César E. Chávez National Monument (La Paz) which was developed during Section 106 consultation.

Figure 2-1 illustrates the alternatives considered in this Final EIR/EIS. The alternatives are designed to a preliminary level sufficient to identify and analyze potential environmental impacts. This Final EIR/EIS describes the Bakersfield to Palmdale Project Section alternatives and analyzes the potential environmental impacts of implementing the B-P Build Alternatives, including direct and indirect impacts and cumulative impacts. It also identifies mitigation measures when there are unavoidable impacts. The design drawings that support the alternatives' descriptions are included as Volume III (Alignments and Other Plans) of the EIR/EIS.



SOURCE: National Geographic/Esri (2015); CHSRA (4/2016, 6/2016, 8/2018, 11/2019)

Source: California High-Speed Rail Authority, 2020

Figure 2-1 Bakersfield to Palmdale Project Section—Alignment Alternatives

2.1.1 Independent Utility

As discussed in Chapter 1, the Authority and FRA divided the HSR system established with Tier 1 decisions into individual project sections for Tier 2 planning, environmental review, and decision-making (Figure 1-2). The Authority, consistent with regulations issued by the Federal Highway Administration (FHWA) and Federal Transit Administration, considers three criteria when determining the scope of a project to be considered in an EIS: (1) whether it connects “logical termini” and has “sufficient length to address environmental matters on a broad scope”; (2) whether it has “independent utility or independent significance,” meaning it will “be usable and be a reasonable expenditure even if no additional transportation improvements in the area are made”; and (3) whether it will “restrict consideration of alternatives for other reasonably foreseeable transportation improvements” (Code of Federal Regulations [C.F.R.] Title 23, Part 771.111(f)). FHWA defines *logical termini* as the rational starting and ending points for a transportation improvement project and for review of the environmental impacts of the project (FHWA 1993).[1] The Bakersfield to Palmdale Project Section connects logical termini at planned passenger stations where HSR service could be provided: at the Bakersfield Station to the north and at the Palmdale Transportation Center to the south. If other project sections of the HSR system are not completed, the infrastructure could be used by regional and intercity services to improve their capacity, reliability, and performance (Authority 2009a).

2.2 Background

2.2.1 California High-Speed Rail System Background

The Authority, a state governing board formed in 1996, is responsible for planning, designing, constructing, and operating the California HSR System. Its statutory mandate is to develop an HSR system that coordinates with the state’s existing transportation network, which includes intercity rail and bus lines, regional commuter rail lines, urban rail and bus transit lines, highways, and airports. The California HSR System will provide intercity, high-speed service on more than 800 miles of tracks throughout California, connecting the major population centers of Sacramento, the San Francisco Bay Area, the southern Central Valley, Los Angeles, the Inland Empire, Orange County, and San Diego. It will use state-of-the-art, electrically powered, high-speed, steel-wheel-on-steel-rail technology, including contemporary safety, signaling, and automated train control (ATC) systems, with trains capable of operating up to 220 miles per hour (mph) over a fully grade-separated, dedicated track alignment.

2.2.2 Bakersfield to Palmdale Project Section EIR/EIS Background

The Bakersfield to Palmdale Project Section would be a critical link in the Phase 1 HSR system, connecting San Francisco and the Bay Area to Los Angeles and Anaheim. In 2005, the Authority and FRA relied on program EIR/EIS documents (see Section 1.1.2, Decision to Develop a Statewide High-Speed Rail System) to select the State Route (SR) 58/Soledad Canyon route for further study between Bakersfield and Palmdale. Therefore, the project EIR/EIS for the Bakersfield to Palmdale Project Section focuses on alignment alternatives along the general SR 58 and Union Pacific Railroad (UPRR) corridor. Figure 2-2 (taken from the *Bakersfield to Palmdale Scoping Report* [Authority 2009f]) illustrates this corridor.

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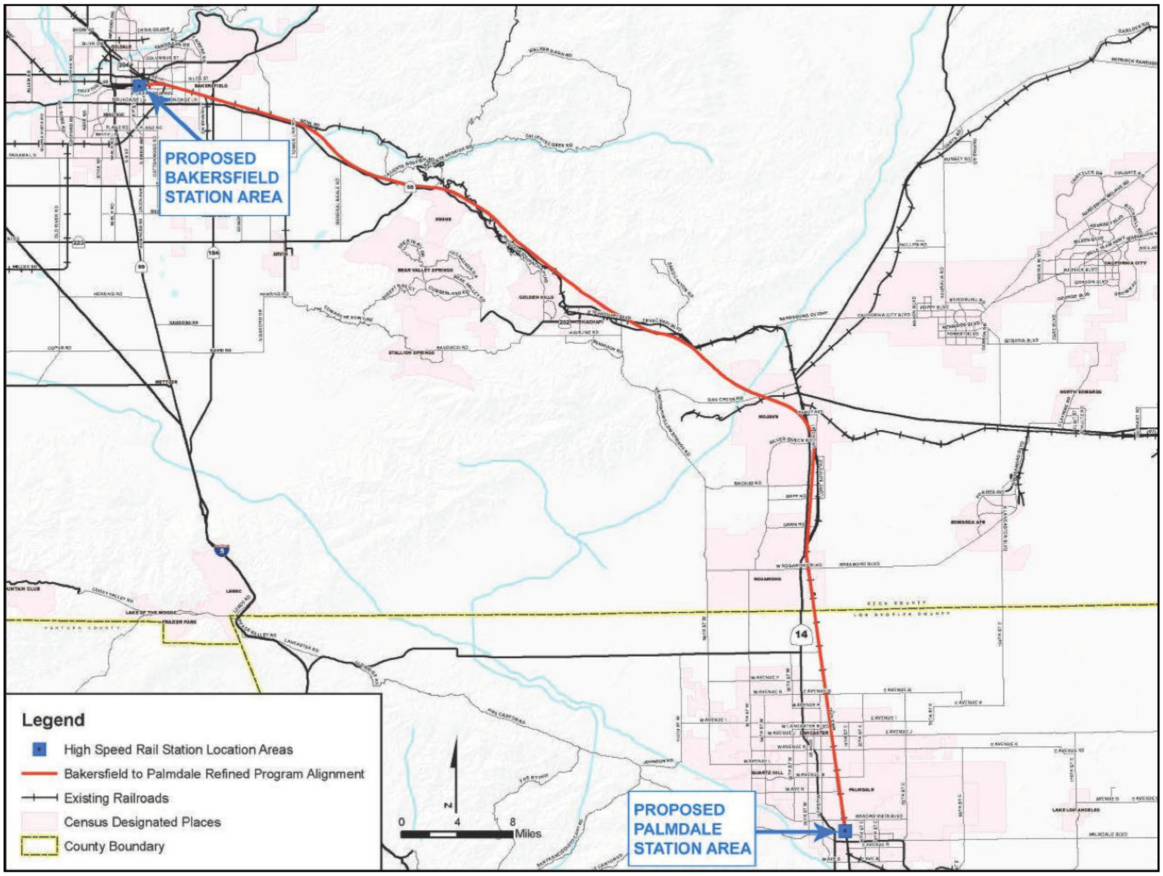
[1] The FHWA criteria for determining project scope, as established in 23 C.F.R. 771.11(f), do not specifically address the scope of individual projects considered in the second tier of a tiered National Environmental Policy Act (NEPA) process. With the tiered NEPA process, the same general principles apply, but they are applied in the context of the decisions made in Tier 1 (in this case, the decision to build the HSR system as a whole). Therefore, in determining the scope of individual project sections for Tier 2 studies, the Authority has focused primarily on determining whether each project section could serve a useful transportation purpose on its own and ensuring that a decision in one project section does not limit the consideration of reasonable alternatives for completing the HSR system in an adjacent project section for which the NEPA process has not yet been completed.



Source: California High-Speed Rail Authority, 2009f

Figure 2-2 State Route 58 and Union Pacific Railroad Corridor

The Authority and FRA have actively engaged local representatives and public agencies, business and agricultural interests, the general public, and the communities along the corridor in the development of the Bakersfield to Palmdale Project Section. As part of this outreach, the Authority and FRA began a project-level environmental review of the Bakersfield to Palmdale Project Section consistent with CEQA and National Environmental Policy Act (NEPA) requirements by issuing a CEQA Notice of Preparation of an EIR on August 24, 2009, and publishing a NEPA Notice of Intent to Prepare an EIS in the Federal Register on September 4, 2009. In September 2009, the Authority and FRA held scoping meetings to receive input on the scope of issues that should be analyzed in the EIR/EIS. A scoping report documenting the results of this process was published in December 2009. The extensive public and agency involvement that has occurred since then has kept the Authority apprised of additional scoping issues as the project has evolved.

2.3 High-Speed Rail System Infrastructure

This section provides general information about the performance criteria, infrastructure components and systems, and function of the proposed HSR system as a whole. Detailed information on each alternative considered in the Bakersfield to Palmdale Project Section is provided in Section 2.5, including alignment, traction power, utility power, and maintenance facility location alternatives. As mentioned above, the HSR system is envisioned as a state-of-the-art, electrically powered, high-speed, steel-wheel-on-steel-rail technology, and would employ the latest technology, safety, signaling, and ATC systems. The trains would be capable of operating at speeds of up to 220 mph over fully grade-separated, dedicated track.

The infrastructure and systems of the proposed B-P Build Alternatives consist of trains (i.e., rolling stock), tracks, grade-separated right-of-way, stations, train control, power systems, and maintenance facilities. The design of each B-P Build Alternative includes a double-track rail system to accommodate planned project operational needs for high-capacity rail movement. Additionally, the HSR system safety criteria recommend avoiding surface intersections on dedicated HSR alignments. This means that planning the HSR system also requires grade-separated overheads or underpasses for roadways or roadway closures and modifications to existing systems that do not span the planned right-of-way.

2.3.1 System Design Performance, Safety, and Security

The proposed California HSR System is designed for optimal performance in conformance with industry standards and federal and state safety regulations (Table 2-1). In dedicated HSR project sections, such as the Bakersfield to Palmdale Project Section, the HSR right-of-way would be fully grade-separated and access-controlled with intrusion detection and monitoring systems. In areas where HSR operates at speeds greater than 125 mph and is adjacent to existing freight railroads, intrusion-protection barriers may be required to prevent encroachment into the HSR guideway. The capital cost estimates, presented in Chapter 6 of this EIR/EIS, include allowances for appropriate barriers (fences and walls) and state-of-the-art communication, access control, and monitoring and detection systems. Not only would the guideway be designed to keep persons, animals, and obstructions off the tracks, but the ends of the HSR trainsets would include a collision response management system to minimize the effects of a collision. The HSR system would conform to the latest federal requirements regarding transportation security. The HSR trainsets (i.e., train cars) would be pressure-sealed to maintain passenger comfort regardless of aerodynamic change, much like an airplane body does. Additional information regarding system safety and security is provided in Section 3.11, Safety and Security.

Table 2-1 High-Speed Rail Performance Criteria

Category	Criteria[1]
System Design Criteria[1]	▪ Electric propulsion system ▪ Fully grade-separated guideway ▪ Fully access-controlled guideway with intrusion-monitoring systems where required ▪ Track geometry to maintain passenger comfort criteria (smoothness of ride, lateral or vertical acceleration less than 0.1 g [i.e., acceleration because of gravity])
System Capabilities	▪ Capable of traveling from San Francisco to Los Angeles in approximately 2 hours and 40 minutes ▪ All-weather/all-season operation ▪ Capable of a sustained vertical gradient of 2.5 percent without considerable degradation in performance[2] ▪ Capable of operating parcel and special freight service as a secondary use ▪ Capable of safe, comfortable, and efficient operation at speeds over 200 mph ▪ Capable of maintaining operations at 3-minute headways ▪ Equipped with high-capacity and redundant communications systems capable of supporting fully automatic train control
System Capacity	▪ Fully dual-track mainline with offline station stopping tracks ▪ Capable of accommodating a wide range of passenger demand (up to 20,000 passengers per hour per direction) ▪ Capable of accommodating normal maintenance activities without disruption to daily operations

Category	Criteria[1]
Level-of-Service	▪ Capable of accommodating a wide range of service types (express, semi-express/limited-stop, and local)

[1] These criteria apply to dedicated HSR sections.
[2] Variances have been considered and approved where constraints warrant such consideration and the variances are feasible.
g = acceleration due to gravity mph = mile(s) per hour

HSR operation would follow safety and security plans developed by the Authority. These plans include the following:

- A Safety and Security Management Plan, including a Safety and Security Certification Program, has been developed to address safety, security, and emergency response as they relate to the day-to-day operation of the system.
- A Threat and Vulnerability Assessment for security, a Preliminary Hazard Analysis, and a Vehicle Hazard Analysis produced comprehensive design criteria for safety and security requirements mandated by local, state, and federal regulations and industry best practices.
- A Fire and Life Safety and Security Program (Technical Memorandum [TM] 500.4 [Authority 2012d]) has been developed, and a System Security Plan is in development. Under federal and state guidelines and criteria, the Fire and Life Safety Plan and Security Program would address the safety of passengers and employees as it relates to emergency response. The System Security Plan would address HSR design features intended to maintain security at the stations, within the trackwork right-of-way, and on board trains.

Design criteria address FRA safety standards and requirements as well as a possible Petition for Rule of Particular Applicability that addresses specifications for key design elements of the system. The FRA is currently developing safety requirements for HSR systems for use in the U.S. FRA will require that the HSR safety regulations be met prior to revenue service operations. The following sections describe those system components pertinent to the Bakersfield to Palmdale Project Section.

2.3.2 Vehicles

Although the exact vehicle type has not yet been selected, the environmental analyses considered the impacts associated with any of the HSR vehicles produced in the world that meet the Authority's criteria. All of the world's HSR systems in operation today use electric propulsion with power supplied by an overhead system. These include, among many others, the *Train à Grande Vitesse* in France, the *Shinkansen* in Japan and Taiwan, and the InterCity Express in Germany. Figure 2-3 shows examples of typical HSR systems.

Figure 2-3 Examples of Japanese *Shinkansen* High-Speed Trains

The Authority is considering an electric multiple-unit concept that would equip several train cars (including both end cars) with traction motors, as compared to a locomotive-hauled train (i.e., one engine in the front and one in the rear). Each train car would have an active suspension, and each powered car would have an independent regenerative braking system (which returns power to the power system). The body would be made of lightweight but strong materials and would have an aerodynamic shape to minimize air resistance, much like a curved airplane body.

A typical train would be 9 to 11 feet wide and would consist of two trainsets, each approximately 660 feet long, and eight cars. A train with two trainsets would seat up to 1,000 passengers and would be approximately 1,320 feet long with 16 cars. The power would be distributed to each train car via the overhead contact system (OCS) (which is a series of wires strung above the tracks) and through a pair of pantographs that reach like antennae above the train (Figure 2-4). Each trainset would have a train control system that could be independently monitored with override control while also communicating with the systemwide Operations Control Center. Phase 1 HSR service is expected to need up to 78 trainsets in 2040, depending on the HSR fares charged and ridership levels (Authority 2017).[2]

Figure 2-4 Example of an At-Grade Profile Showing Contact Wire System and Vertical Arms of the Pantograph Power Pickups

[2] The *Horizon Year 2040 Operations and Service Plan* envisions the need for 71 revenue trainsets. The total estimated trainsets include allowance for spare trainsets for maintenance and repair, substitute and hot standby trainsets, and extra trainsets to accommodate higher demand on peak-demand days, resulting in an overall fleet estimate of 78 total units. The 10 percent total spare ratio falls within the middle range of spare ratios for other U.S. and international intercity and HSR fleets.

2.3.3 Stations

Stations are sized for projected HSR ridership and designed to provide flexibility to accommodate future growth. Station facilities include public and nonpublic areas, station site improvements to facilitate intermodal connectivity and station accessibility, and ancillary facilities. For existing stations modified for HSR service, public areas and station site improvements would be shared with other rail operators serving the station.

Station design is developed at a concept level—preliminary engineering for project definition—for project-level environmental analysis and documentation, sufficient for disclosing the environmental impacts of building and operating a station. Figure 2-5 shows examples of station components from existing systems overseas; Figure 2-6 shows a potential "functional" station and a plan view of various station components. The functional station is a basic design that could be more elaborate with cooperation from the local jurisdiction; the station has the potential to be an iconic building that would help define the downtown transit core.

Station Parking Facilities

Parking demand estimates are based on HSR system ridership forecasts that assume initial parking availability is unconstrained (i.e., 100 percent of parking demand is met). These projections provide a "high" starting point to inform discussions with cities where stations are proposed. Based on a constraints analysis undertaken in consultation with station cities, this Project EIR/EIS identifies locations for parking facilities needed to satisfy the maximum forecast constrained demand. Station access facilities are anticipated to be developed over time in phases while also prioritizing access to the HSR system through modes such as transit, which could lead to lower parking demand. See HSR System Ridership and Station-Area Parking in Section 2.6.3 for additional information.

Figure 2-5 Examples of Existing Stations

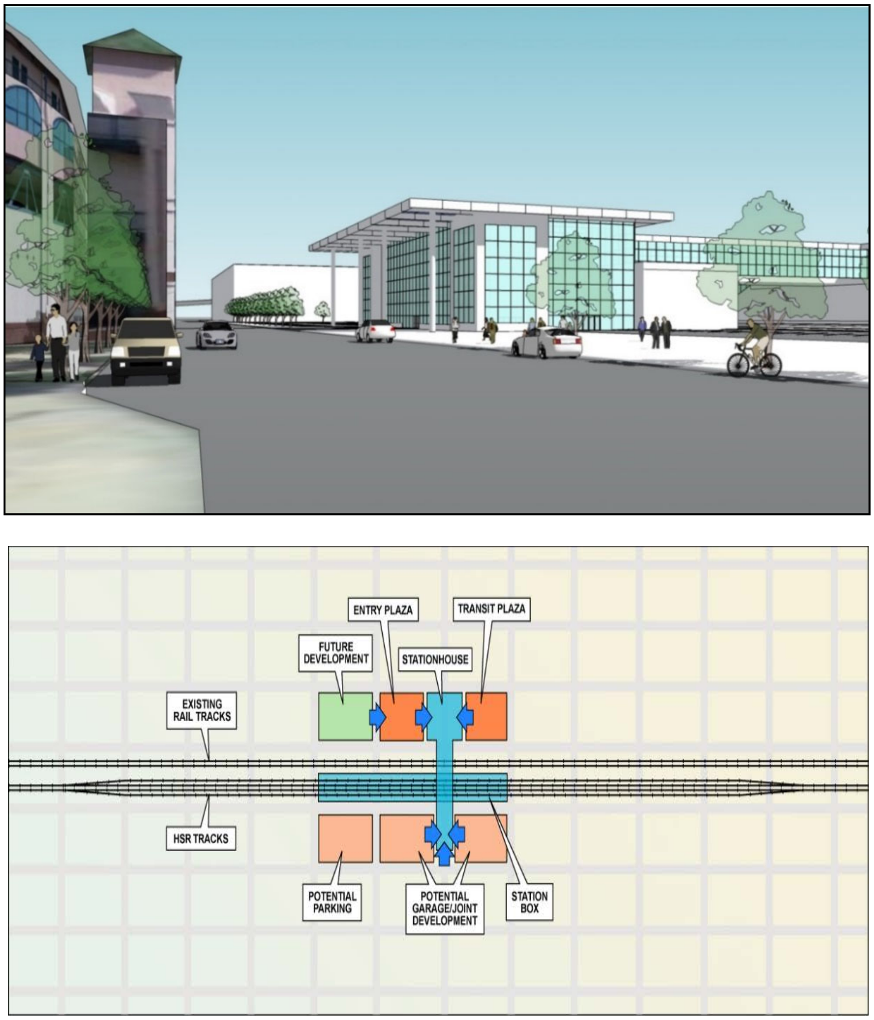


Figure 2-6 Simulated and Plan Views of a Functional Station and Its Various Components

Preliminary station planning and design are based on dimensional data from the *Station Platform Geometric Design* guidance (Authority 2010a), as well as volumetric data from the *Station Program Design Guidelines* (Authority 2011b), and also incorporate the Authority's *Urban Design Guidelines* (Authority 2011d). All stations would be designed in accordance with Americans with Disabilities Act (ADA) accessibility guidelines.

The Bakersfield to Palmdale Project Section would include two stations, one in Bakersfield and one in Palmdale. Analysis of the Bakersfield Station (including the subsection extending from the Bakersfield Station to Oswell Street) is included in the Fresno to Bakersfield Project Section documents (including the Fresno to Bakersfield Section Draft Supplemental EIR/EIS [Authority and FRA 2017], Fresno to Bakersfield Section Final Supplemental EIR for the Locally Generated Alternative [LGA] [Authority 2018a], and Final Supplemental EIS for the Fresno to Bakersfield LGA [Authority 2019c]) and is incorporated by reference in this document. In October 2018, the Authority Board certified the Final Supplemental EIR and approved the LGA through the 34th Street and L Street intersection, including the F Street Station. In October 2019, the Authority issued the Record of Decision and Final Supplemental EIS for the Fresno to Bakersfield LGA. In taking this action, the Authority Board reserved making a decision on the alignment from south of the F Street Station to Oswell Street to its future action on the Bakersfield to Palmdale Project Section.

2.3.3.1 Station Platforms and Trackway (Station Box)

> *Maintenance-of-Way Facility*
>
> A train-industry term that refers to repair and maintenance activity concerning the right-of-way and track, including track and roadway, buildings, signals, and communication and power facilities.

The station would provide a sheltered area and platforms for passenger waiting and circulation elements (e.g., stairs, elevators, escalators). Of the four tracks passing through the station, the two express tracks (for trains that do not stop at the station) would be separated from those that stop at the station and platforms. To allow enough distance for safe deceleration of trains, a platform track would diverge from each mainline track beginning 3,000 feet from the center of the 1,410-foot station platform. The acceleration track from platform to mainline requires a shorter distance. An additional 1,650-foot stub-end refuge track would be provided to temporarily store HSR trains in case of mechanical difficulty, for special scheduling purposes, and for daytime storage of maintenance of infrastructure work trains during periods when structure and track maintenance is being performed along the line around the station. The combination of deceleration, acceleration, and refuge track would extend the wider footprint of the four-track section to a minimum total length of 6,000 feet.

2.3.3.2 Station Facilities Building

Station public areas include entry plazas and building entrances; ticketing; wayfinding/signage; publicly accessible restrooms; concessionaire-provided amenities such as food service, rental car counters, and retail uses; vertical circulation; concourse or mezzanine areas with passenger waiting areas; fare gates; controlled paid areas; and platforms. Pedestrian over-track bridges and under-track passageways enable public access across the rail right-of-way at stations. Station nonpublic areas include administrative, maintenance, operations, safety/security, loading, and back-of-house circulation areas.

Station site improvements provide safe and efficient access for pedestrians, bicycles, transit, and personal vehicles to and from the station. Pick-up and drop-off zones offer direct and convenient access for taxis, ride hailing/sharing services, shuttles, transit, and private and commercial vehicles. Parking supply estimates are based on projected parking demand and local conditions. Station site plans are configured to support transit-oriented development. Ancillary facilities are unoccupied back-of-house spaces required for station operations and maintenance, including normal, back-up, and emergency power systems.

2.3.4 Infrastructure Components

The dedicated, fully grade-separated infrastructure needed to operate high-speed trains has more stringent alignment requirements than those needed for lower-speed trains. The B-P Build Alternatives would use five different track sections. These track sections would have varying profiles: surface tracks are low and near the ground, higher tracks are elevated or on fill (earth), and underground tracks are in a cut or tunnel. Types of bridges that might be built include pre-cast, cast-in-place, and balanced cantilever segmental (which can be pre-cast or cast-in-place). A single tunnel with a dividing wall would be used for tunnels less than approximately 1 mile in length. The single tunnel can be built using standard drill and blast or sequential excavation methods. Dual-bore tunnels are planned for tunnels greater than 1 mile in length and include evenly spaced cross passages for maintenance and emergency access. The dual-bore tunnels are smaller in diameter than the single tunnels, and it is expected that it would be more economical for them to be built using a tunnel boring machine (TBM). The various track sections are described below.

2.3.4.1 At-Grade Sections

At-grade track sections (Figure 2-7) are best suited in areas where the ground is relatively flat, as in the Central Valley, and in rural areas where interference with local roadways is infrequent. The at-grade track would be built on compacted soil and ballast material (a thick bed of angular rock) to minimize subsidence or changes in the track surface from soil movement. For at-grade track, the rail would be built above the 100-year floodplain or higher. The height of at-grade sections may vary to accommodate slight changes in topography and to provide clearance for stormwater culverts and structures in order to allow water flow as well as occasional wildlife movement. Off-site culverts will be placed to convey off-site flow.

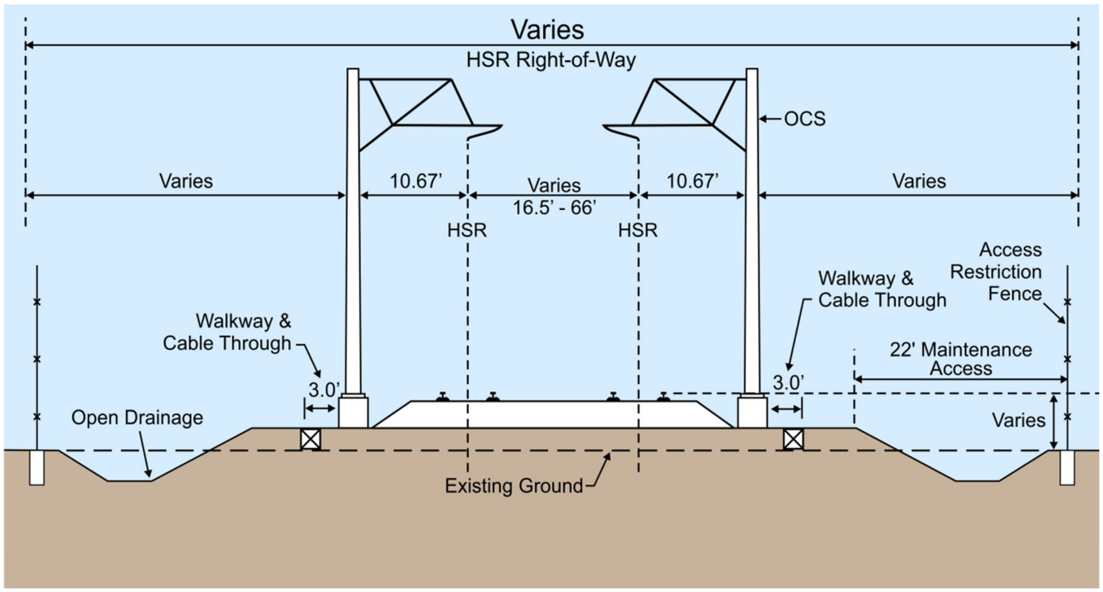


Figure 2-7 Typical At-Grade Cross Section

2.3.4.2 Fill Sections

Fill sections (Figure 2-8) are used where it is necessary to raise the rail alignment so it is able to cross over existing surface-level rail tracks, roads, or highways on a viaduct. The guideway would be raised off the existing ground on a fill platform with 2:1 side slopes or flatter. Fill sections are also necessary intermittently when traversing mountains or irregular terrain to cross over intermittent low points and drainage crossings. Figure 2-8 represents a typical design and does not indicate the actual height of fills.

2.3.4.3 Cut Sections

Cut sections (Figure 2-9) are used when the rail profile needs to be lowered so it can cross under existing surface-level rail tracks, roads, or highways, or in mountainous regions. The cut section embankment heights vary from 0 feet to 270 feet and are benched every 30 feet vertically. The guideway would be lowered below the existing ground with 2:1 slopes or flatter. Cut sections are used mainly for short distances in highly urbanized and other constrained situations, or when traversing mountainous or irregular terrain to cross through intermittent high points and ridges, such as the Tehachapi Mountains. In some cases, it is less disruptive to the existing traffic network to depress the rail profile under these crossing roadways. Cut sections are also used for roads or highways when it is more desirable to depress the roadway underneath a surface HSR alignment. Retaining walls are also used to minimize the impact area by preventing the grading catch points from chasing existing slopes or to avoid ground features. The retaining wall heights vary from 6 feet to 88 feet, and the retaining wall lengths vary from 33 feet to 1,135 feet.

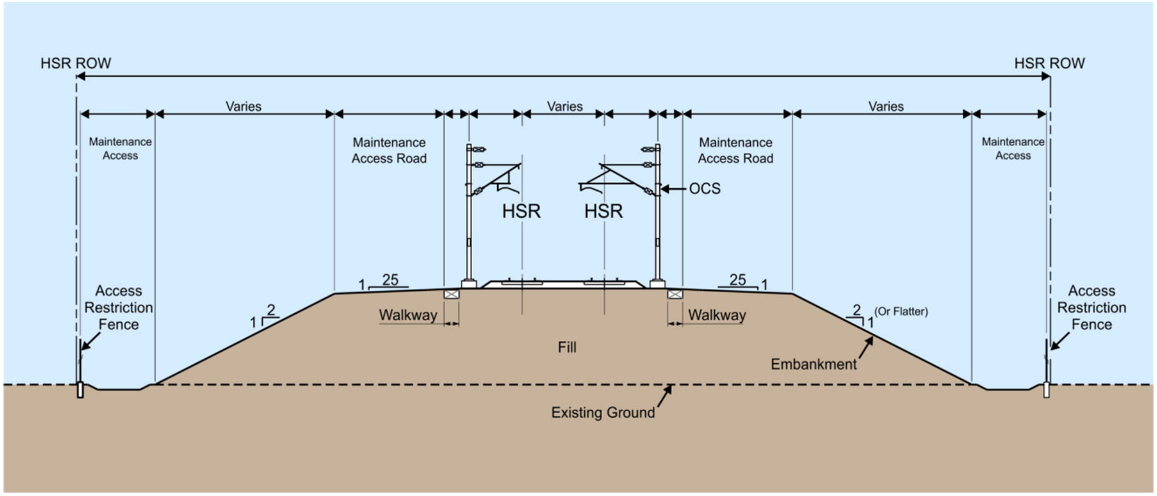


Figure 2-8 Typical Fill Cross Section

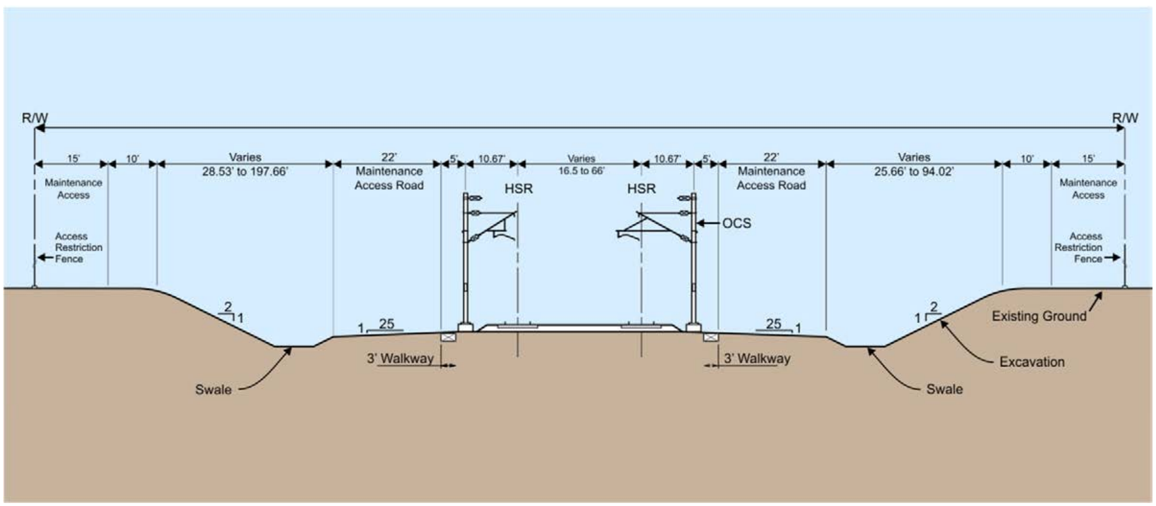


Figure 2-9 Typical Cut Cross Section

2.3.4.4 Tunnel Sections

Tunnel sections (Figure 2-10, Figure 2-11, and Figure 2-12) are used when the rail alignment traverses highly variable topography or highly constrained, densely developed urban situations. Tunnel sections reduce track distance and curvature needed to maintain acceptable vertical grades and horizontal curvature in mountainous terrain.

The tunnels have two basic configurations: a single tunnel containing both tracks and dual-bore tunnels with a single track in each tunnel. Some locations would require cut-and-cover tunnels for short distances. The selected configuration would depend on alignment, ground conditions, construction method, portal configuration, approach structures, fire and life safety, and operations and maintenance considerations.

Each dual-bore tunnel (Figure 2-10) would have an internal diameter of approximately 28 feet, with typical center-to-center spacing for the twin tunnels of 66 feet. Cross passages would connect the dual-bore tunnels at intervals to move equipment and to evacuate passengers from one tunnel to the other in the event of an incident.

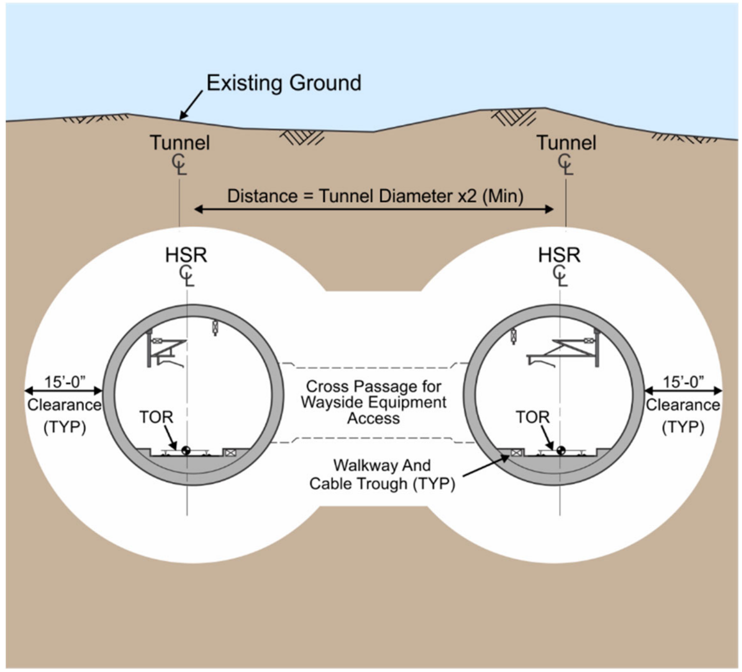


Figure 2-10 Dual-Bore Tunnel Typical Cross Section

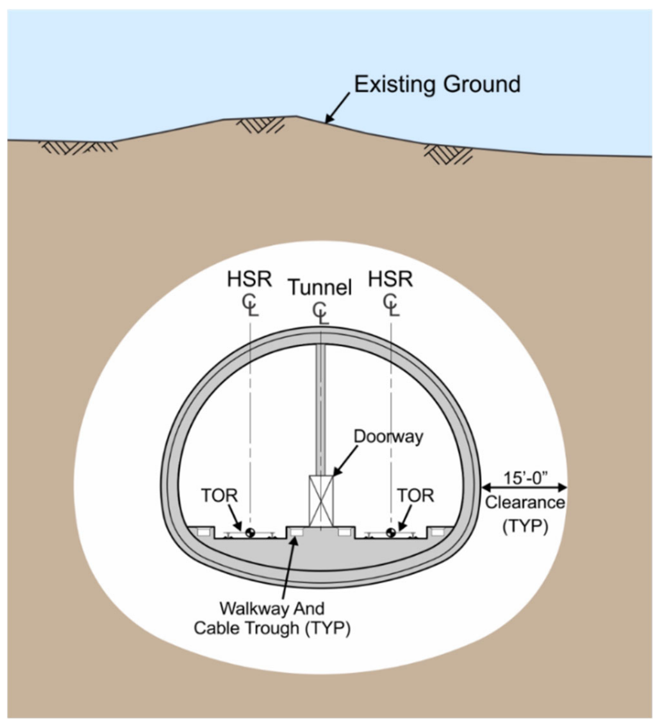


Figure 2-11 Single Tunnel Typical Cross Section

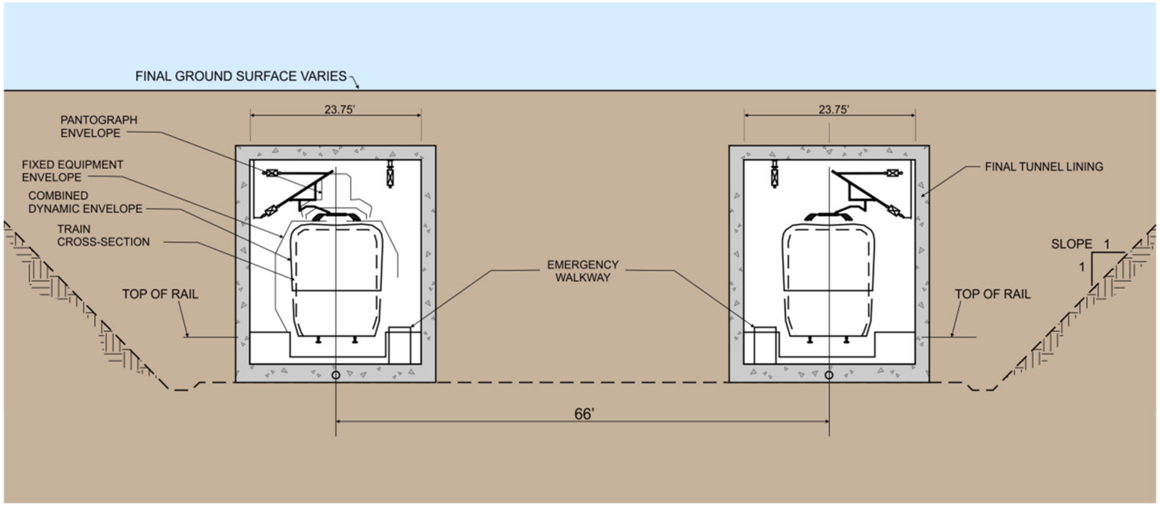


Figure 2-12 Cut-and-Cover Tunnel Typical Cross Section

The size of the single tunnel (Figure 2-11) would depend on the type of construction used. The single tunnel would have an internal width of approximately 49 feet. The minimum distance between track centerlines would be approximately 25 feet, and there would be a separation wall in the tunnel between the two tracks. Walkways would be provided on either side of the separation wall. Doorways placed at regular intervals in the separation wall would allow movement from one side of the tunnel to the other. Walkways would be installed along the sidewalls of the tunnel. All tunnels should be fully lined in some areas for structural, water and gas tightness, and aerodynamic reasons (Authority 2012e).

Each cut-and-cover tunnel (Figure 2-12) would have an internal width of approximately 23.75 feet, and the typical center-to-center spacing for the twin tunnels would be 66 feet. Vents are not provided for the Bakersfield to Palmdale Project Section because of the relatively short length of the tunnels proposed, but jet fans have been provided where required for ventilation.

2.3.4.5 Tunnel Portals

Tunnel portals provide a transition from the tunneled sections to cut, at-grade, or elevated sections. Figure 2-13 shows an example of a tunnel portal. During construction, portals serve as the primary access to the tunnels. In the permanent configuration, facilities and infrastructure elements would be located at the portals to support HSR tunnel operations, including all provisions needed to meet first responder, fire and life safety, and ventilation requirements. *High-Speed Train Tunnel Portal Facilities*, *TM 2.4.6* (Authority 2010b) identifies portal infrastructure elements to be considered for the HSR system tunnels and describes the permanent structures associated with the tunnel portals for the Bakersfield to Palmdale Project Section, including a representative layout of these elements. It also provides general guidance used to determine which elements of the portal infrastructure are required; the principal factors influencing these decisions are tunnel length, the proximity of tunnels to the portals, accessibility, and environmental impacts.

Source: California High-Speed Rail Authority and Federal Railroad Administration, 2017

Figure 2-13 Tunnel Portal

Permanent Portal Facilities

The following major portal infrastructure elements are incorporated in the portal design, based on preliminary engineering design, and are subject to change as the project design is refined:

- **Noise Attenuation Hood**
  - Up to 150 feet long to prevent aerodynamic noise effects at the portals
- **Portal Ventilation Building**
  - Three-story, roughly 65-foot-tall building housing assemblies of fans at the portals to extract smoke from the tunnels in the event of fire
  - Requires direct access to the tunnels and is located immediately over the tunnel portal
- **Access Road**
  - Provides access to portals required for emergency responders, evacuating passengers, and maintenance staff
  - A 22-foot-wide access road runs up and around the portal ventilation building to provide access to the third floor
- **Emergency Vehicle Assembly and Turnaround Area**
  - Located adjacent to the tunnel portal
  - Minimum 75-foot by 75-foot area
- **Rescue Area/Passenger Assembly Area**
  - 5,000-square-foot minimum
  - As close as practical to the tunnel portal
  - Well lit

- **Fire Hydrants and Water Supply**
  - Needed for tunnel firefighting purposes
  - Supplied by the 4-inch water line proposed along the alignment for tunnel water needs
- **Area Lighting**
  - Lighting system needed to illuminate the portal site during a train evacuation
- **Train Surface Evacuation and Fire Control Zone**
  - Located immediately outside the portal where a train exiting a tunnel under emergency conditions can stop to allow passengers to safely disembark
  - Allows emergency responders to reach the train for emergency situations.
- **Communication Facilities**
  - Communication tower (approximately 100 feet in height and 6 feet in diameter) may be required to enable reliable transmission
- **Rock Fall and Debris Containment**
  - Trench excavations or berms to ensure materials from slopes in the portal area cannot reach the tracks or damage equipment or structures
- **Detention Pond**
  - Required to handle stormwater runoff for each portal location (detention pond less than 1 acre in size)
- **Parking for Tunnel Maintenance and Traction Power Facilities**
  - Approximately eight spaces provided for maintenance staff
- **Public Utilities**
  - May include water, electricity, telephone, and sewer lines

TM 2.4.6 also establishes general guidance for determining which elements of the portal infrastructure are required. The principal factors influencing this decision are:

- Length of tunnel
- Proximity of one tunnel to another
- Accessibility of portal locations
- Environmental impacts at a portal location

2.3.4.6 Elevated Sections

Elevated sections (Figure 2-14 and Figure 2-15) can be used in urban areas where extensive road networks must be maintained. They may also be used in rugged, mountainous, or otherwise uneven terrain to ensure a level track and reduce the impacts associated with very tall fill section heights or other grade-stabilizing measures. The Bakersfield to Palmdale Project Section would traverse the Tehachapi Mountain range and would utilize elevated sections ranging in length from approximately 130 feet to 15,580 feet. Elevated sections must have a minimum clearance of approximately 16.5 feet over roadways and approximately 24 feet over railroads. Pier supports would vary between 8 feet and 20 feet in diameter at ground level. Such structures could also be used to cross waterbodies; even though the trackway might be at-grade on either side, the width of the water channel could require a bridge at the same level, which would be built in the same way as the elevated sections. The following figures represent typical design types and do not indicate the actual height of elevated structures.

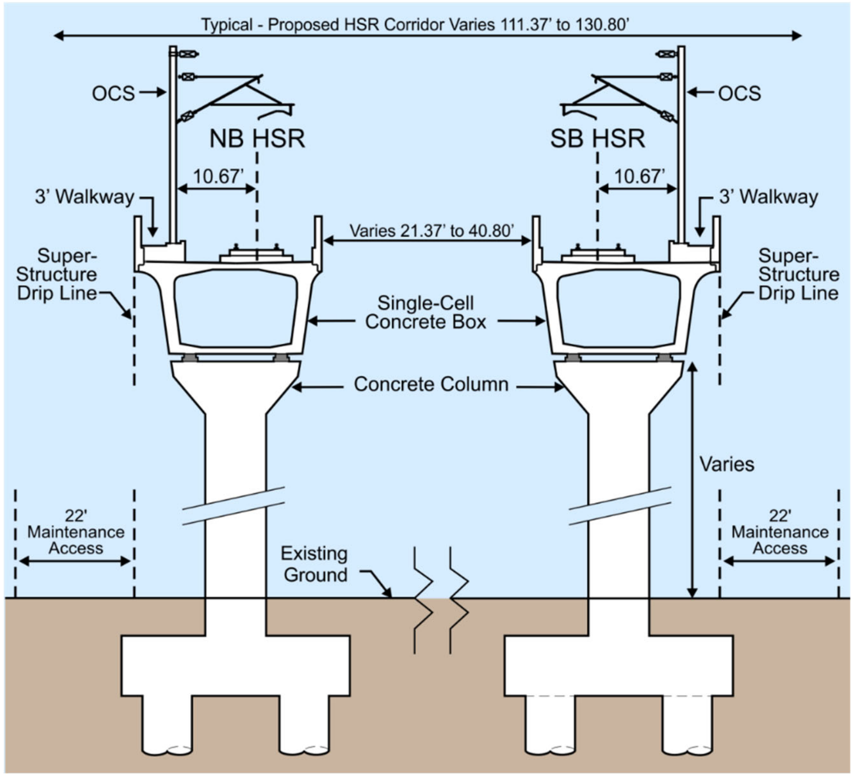


Figure 2-14 Elevated Twin-Structure Typical Cross Sections

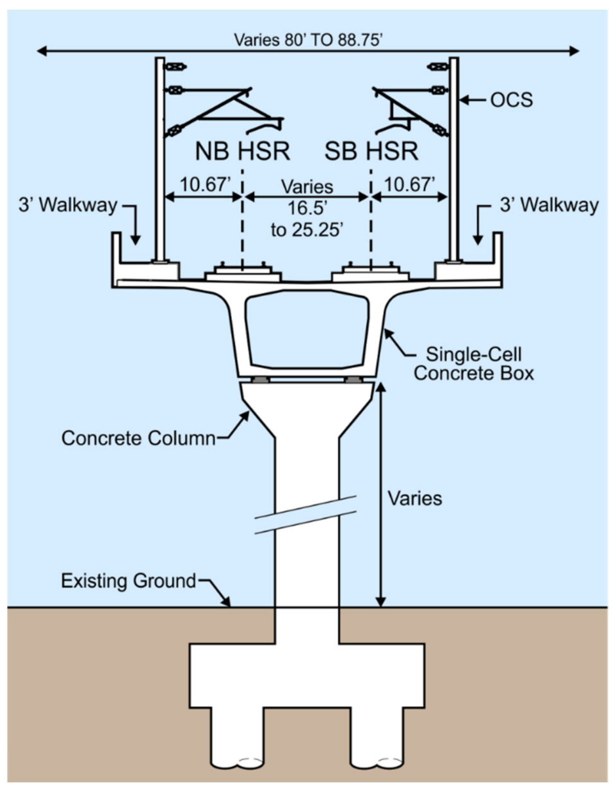


Figure 2-15 Elevated Single-Structure Typical Cross Sections

Elevated sections have two basic configurations: twin structures (Figure 2-14), each with a single track, or a single structure with both tracks (Figure 2-15). Walkways would be provided on the outside of the OCS poles. The selected configuration would depend on track spacing. Each twin structure would be approximately 50 feet wide, except in transition areas where the width of each twin structure would be approximately 59 feet. Additionally, the typical spacing between the twin structures would vary between approximately 21.37 and 40.8 feet. The width of each single structure would vary between approximately 44 and 53 feet, and the typical center-to-center spacing for the twin structure would vary between 16.5 and 25.25 feet.

Straddle Bents

When elevated sections cross over a roadway or railway on a very sharp skew (degree of difference from the perpendicular), a straddle bent ensures that the piers are outside the functional/operational limit of the roadway or railway. As shown on Figure 2-16, a straddle bent is a pier structure that spans (or “straddles”) the functional/operational limit of a roadway, highway, or railway.

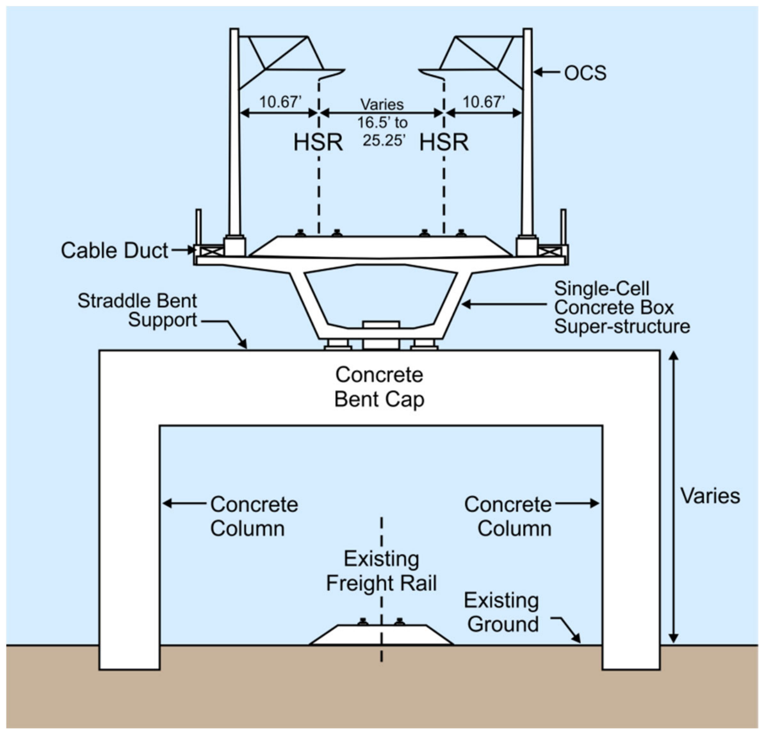


Figure 2-16 Straddle Bent Typical Cross Section

Typical roadway and highway crossings that have a smaller skew angle (i.e., the crossing is nearly perpendicular) generally use intermediate piers in medians and span the functional right-of-way. However, for larger-skew-angle crossing conditions, median piers would result in excessively long spans that are not feasible. Straddle bents that clear the functional right-of-way can be spaced as needed (typically 110 feet apart) to provide feasible span lengths for bridge crossings at larger skew angles.

2.3.5 Grade Separations

An optimally operating HSR system consists of a fully grade-separated and access-controlled guideway. Unlike existing passenger and freight trains in the project vicinity, the HSR system would have no surface road crossings, nor would it share its rails with freight trains. The following list describes possible scenarios for HSR grade separations for roadways, irrigation and drainage facilities, and wildlife:

- **Elevated HSR Road Crossings**—In urban areas, it may be more feasible to raise the HSR as shown on Figure 2-14, Figure 2-15, and Figure 2-16. While this is relevant in mountainous, uneven, or rural areas, it is especially pertinent in downtown urban areas where use of an elevated HSR guideway would minimize impacts on the existing roadway system.
- **Roadway Overheads**—There are many local and state roadway facilities within the Bakersfield to Palmdale Project Section. Where these roads are affected by the HSR alignment, they would be shifted and rebuilt to maintain their function. Road overcrossings would be designed pursuant to the appropriate city and county standards. Figure 2-17 illustrates how a roadway would be grade-separated over both the HSR and the railroad in these situations. Similar conditions occur when a surface HSR alignment crosses rural roads used by small communities and farm operations. Where roads cross the proposed HSR, overheads or underpasses would be proposed based on need (determined by review of existing general plans and traffic data) in order to provide continued mobility for local residents and farm operations. Some roads may be closed and alternate routes provided. The locations for these modifications are identified on project maps, and detailed lists are provided in Appendix 2-A and Appendix 2-B. Figure 2-17, Figure 2-18, and Figure 2-19 are examples of typical roadway overheads, which would vary in width between 25 and 123 feet. Overheads would have two to six 12-foot lanes, depending on the existing roadway facility. They would include shoulders, a bike lane, and a sidewalk, or a combination of these. The minimum clearance height would be 27 feet over the HSR.

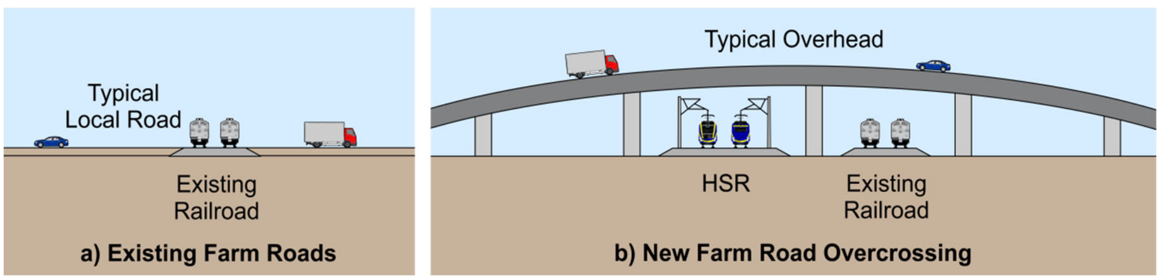


Figure 2-17 Replacing Local Surface Crossings with New Overheads above the High-Speed Rail Guideway and Existing Railroad Trackway

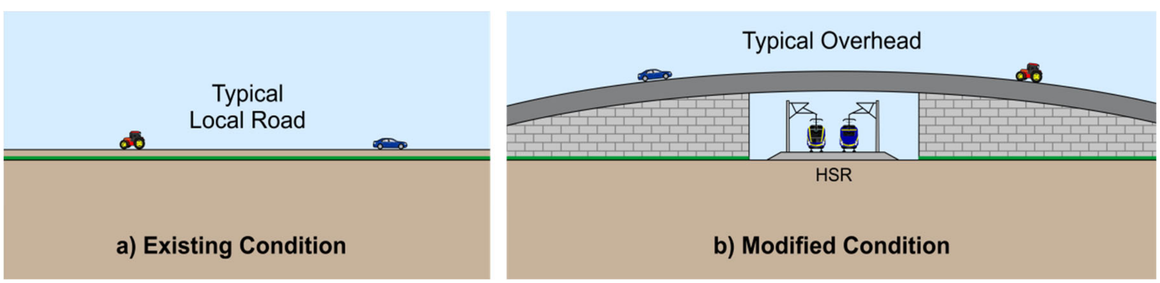


Figure 2-18 Adding Local Roadway Overheads above the High-Speed Rail Guideway

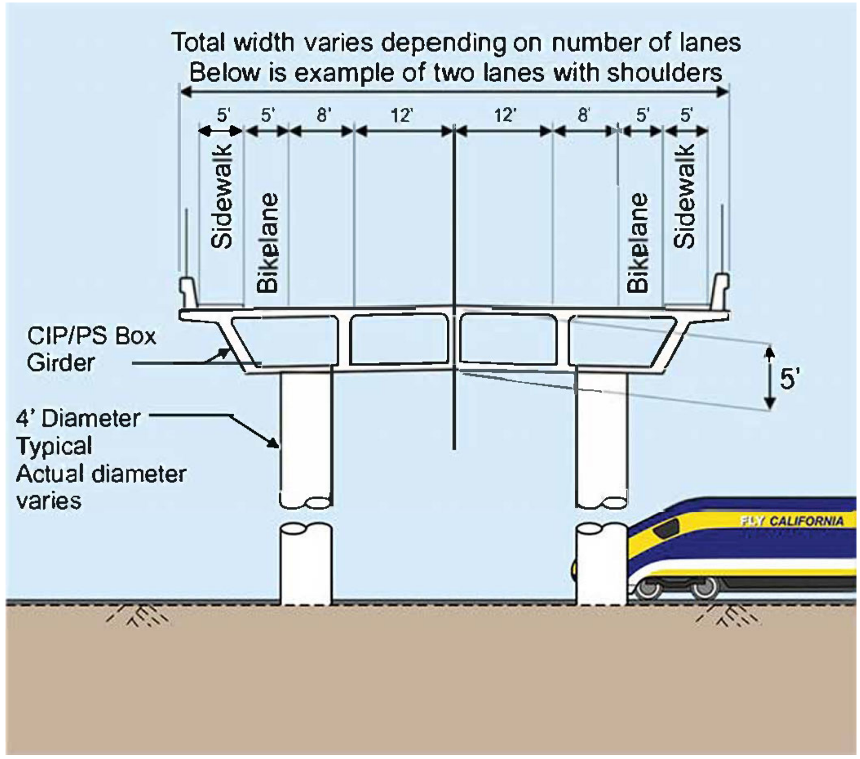


Figure 2-19 Typical Roadway Overhead

- **Tunnels**—The B-P Build Alternatives would require tunneling in certain areas due to topography or other constraints, such as faults, grade limitations, and grade separations. Figure 2-10, Figure 2-11, and Figure 2-12 provide examples of the typical tunnel sections. Tunnels are specifically relevant for the Tehachapi segments or areas with challenging geological features.
- **Roadway Underpasses**—The B-P Build Alternatives would require underpasses for the HSR to travel over roadways. Figure 2-20 illustrates how a roadway would be grade-separated below the HSR guideway. Roadway widths would vary between 10 and 164 feet.

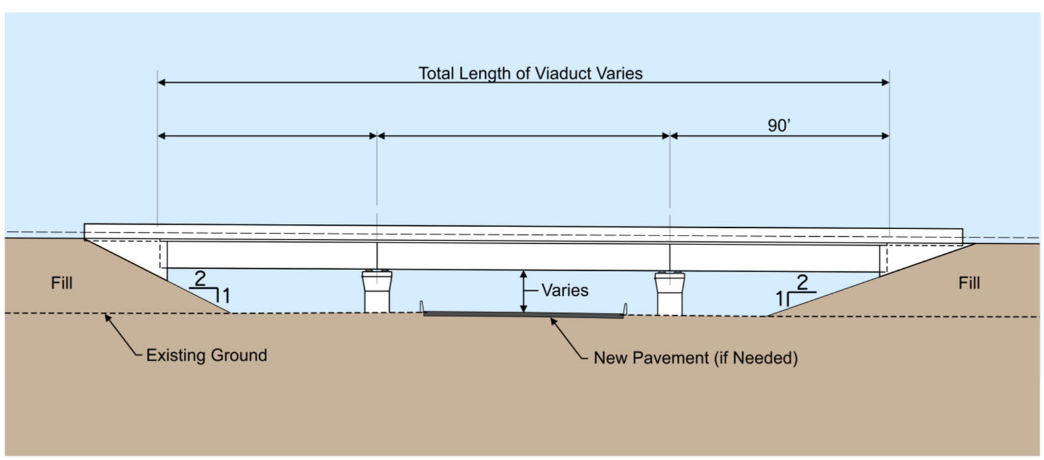


Figure 2-20 Typical Cross Section of Roadway Grade-Separated beneath the High-Speed Rail Guideway

- **Irrigation and Drainage Facilities**—The HSR alignment would affect some existing drainage and irrigation facilities. Depending on the extent of the impact, existing facilities would be modified, improved, or replaced as needed to maintain existing drainage and irrigation functions and to support HSR drainage requirements. Types of drainage crossings that might be built include drainage overheads (bridges), large box culverts, or, for some wider river crossings, limited piers within the ordinary high-water channel.
- **Wildlife Crossing Structures**—Wildlife crossing structures (i.e., crossings over or under the transportation infrastructure) designed for the Bakersfield to Palmdale Project Section primarily consist of a 6-foot concrete arch, perpendicular to the rail, in the embankment that supports the HSR tracks, as illustrated on Figure 2-21 and Figure 2-22. The length of these crossing structures varies depending on the embankment width. The preliminary design includes 39 wildlife crossing structures placed to minimize the HSR project's effects on wildlife permeability. Generally, wildlife crossings were reviewed for fenced at-grade segments at intervals of 0.31 mile for small to medium species and 1 mile for large species, as recommended by Clevenger and Huijser (2011). Wildlife crossing structures to facilitate wildlife movement will conform to the *Wildlife Crossing Structure Handbook Design and Evaluation in North America,* where appropriate, practicable, and feasible (Clevenger and Huijser 2009). Other wildlife crossing design criteria used were less than 200 feet in length, less than 2 percent slope, natural bottom substrate, and near natural grade. The minimum design height requirement of 17.5 feet has been required at roadway crossings. The project design across alternating steep canyons and ridges and adjacent land uses would make it infeasible to achieve both the desired crossing intervals and all design criteria. For example, at some locations, the width of the HSR fill slope adjacent to natural grade would exceed the desired maximum crossing length. Additional design elements, such as the tunnels, elevated sections of the alignment, road overcrossings or undercrossings, and crossings of drainages, would avoid impacts on wildlife movement entirely or minimize those impacts, as the tunneled and elevated sections of the B-P Build Alternatives provide essentially unimpeded connectivity for wildlife.

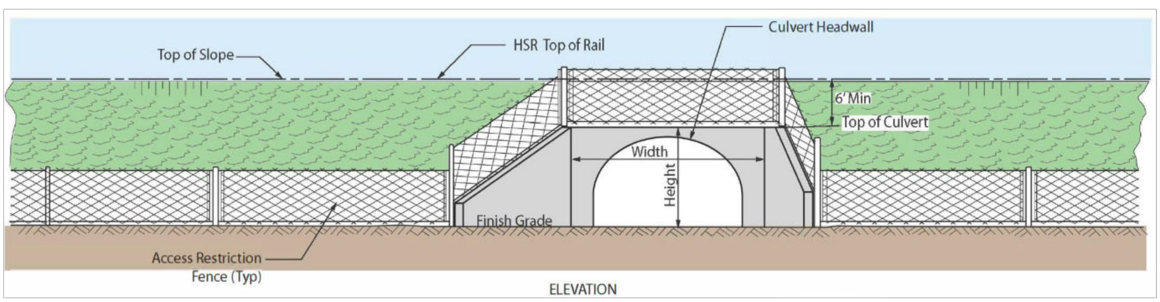


Figure 2-21 Typical Cross Section of Wildlife Crossing Structure

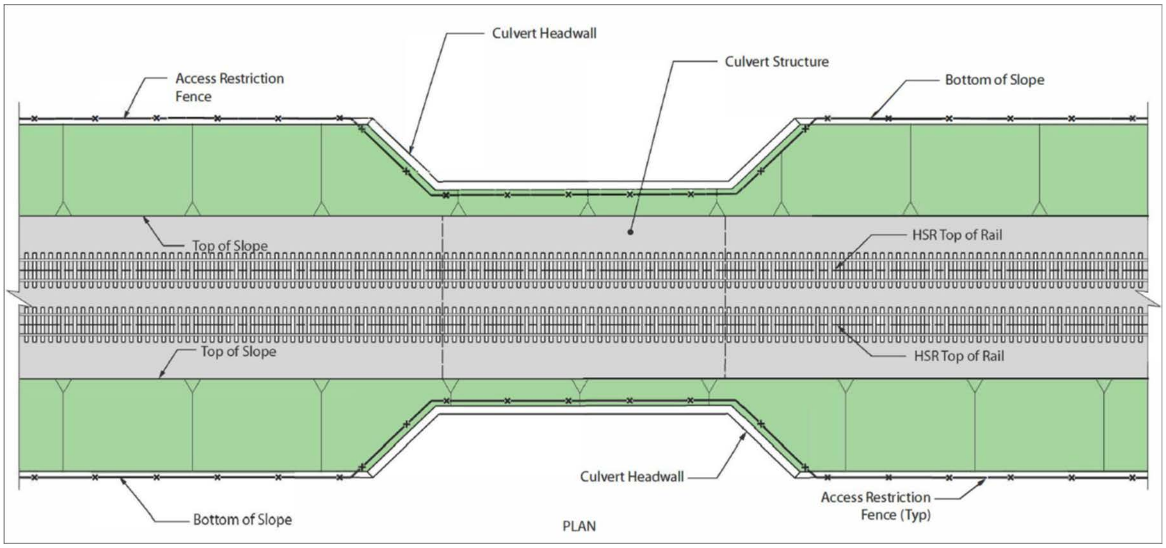


Figure 2-22 Typical Plan View of Wildlife Crossing Structure

To tailor the crossings to specific project locations, the Authority has prepared a *Wildlife Corridor Assessment* (Appendix I of the *Biological and Aquatic Resources Technical Report* (Authority 2018c)) that analyzes site-specific movement corridors to determine design refinements that would incorporate appropriate wildlife crossings as necessary and as feasible. For information on how to access and review technical reports, please refer to the Authority's website at www.hsr.ca.gov. The *Wildlife Corridor Assessment* includes information from, and consultation with, stakeholders and agencies to support design considerations that would facilitate wildlife movement. The assessment identified other important ecoregions for wildlife movement, other areas where wildlife movement may be constrained for various species, appropriate locations and sizes for dedicated crossings, and measures to avoid, minimize, or mitigate the effects.

Section 3.7, Biological and Aquatic Resources, describes the analysis of the proposed project and modifications to the standard wildlife crossing structures where necessary, and it proposes additional mitigation measures necessary to facilitate wildlife movement to the extent such measures are feasible. Such measures include additional design considerations, dedicated wildlife crossing structures, and compensatory mitigation.

Additional wildlife crossing structure designs could include larger structures (10-foot-high concrete arch) to accommodate taller species such as mule deer within their species range. However, at a number of locations, the HSR would be in a cut, below natural grade. In these cases, several overcrossings were designed to accommodate wildlife movement over the HSR alignment. In several instances, wildlife crossings were combined with roads or a drainage; these crossings would consist of a 30-foot-wide dirt shoulder adjacent to the road or drainage. A physical separation or barrier, such as a wall, would be built between the crossing area and the road. In the instances where wildlife crossings are combined with roads or drainages, the wildlife crossing would be visible to wildlife.

2.3.6 Access Roads

Access roads to provide emergency and maintenance access from public roadways to HSR facilities would be required. Access roads would be located continuously along both sides of the tracks except where the alignment is in a tunnel or on a bridge, where roads terminate and walkways are provided. Additional access roads would provide connections from public roadways to HSR facilities in between every tunnel or bridge, providing access to every segment of at-grade track. Access roads within the HSR right-of-way would be paved, with a minimum width of 22 feet. Access roads within the HSR right-of-way would be restricted to use by authorized HSR personnel and emergency responders. Use would be unrestricted from public roads to the HSR right-of-way. All parcels would have roadway access or would be acquired if access to the parcel cannot reasonably be otherwise provided. For more detail on right-of-way acquisitions, see Section 3.12, Socioeconomics and Communities.

Temporary access roads to provide construction access along the HSR alignment in mountainous terrain would be required. These temporary access roads would be removed and restored to a preconstruction condition upon construction completion.

2.3.7 Traction Power Distribution

California's electricity grid would power the proposed HSR system. While it is not feasible to control the flow of electricity from particular sources (Navigant Consulting, Inc. 2008), it is feasible for the Authority to obtain the quantity of power required for the HSR system from 100 percent clean, renewable energy sources through a variety of mechanisms, such as paying a clean-energy premium for the electricity consumed (Authority 2014b).

Implementation of the HSR system would not entail the construction of a separate power source, although it would include the extension of underground or overhead power transmission lines to a series of traction power substations (TPSS) positioned along the HSR corridor. These TPSSs would be needed to even out the power feed from the power supply company to the train system. Working in coordination with power supply companies and in accordance with design requirements, the Authority has identified frequency and right-of-way requirements for these facilities.

Trains would draw electric power from an OCS. The OCS would consist of a series of mast poles approximately 23.5 feet higher than the top of the rail, with contact wires suspended from the mast poles between 17 and 19 feet from the top of the rail. The train would have an arm, called a pantograph, to maintain contact with this wire and provide power to the train (Figure 2-4). The mast poles would be spaced approximately every 200 feet along straight portions of the track and as close as every 70 feet in tight-turn track areas. The OCS would be connected to the switching stations. The power supply would consist of a 2- by 25-kilovolt (kV) OCS for all electrified portions of the statewide system.

Figure 2-23 provides an example of a traction power facility typical cross section, but facility structures can vary significantly.

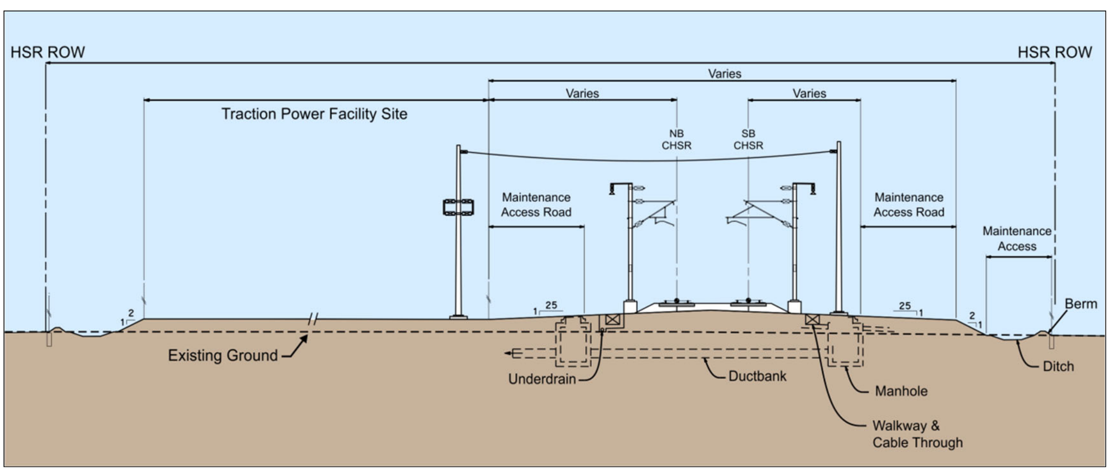


Figure 2-23 Traction Power Facility Typical Cross Section

2.3.7.1 Traction Power Substations

Based on the HSR system's estimated power needs, each TPSS would encompass approximately 32,000 square feet (200 by 160 feet) and be located at approximately 30-mile intervals. Figure 2-24 illustrates a typical TPSS.

Figure 2-24 Traction Power Substation

In the Bakersfield to Palmdale Project Section, TPSSs would be built at locations where high-voltage power lines cross near the HSR alignment. Each TPSS would have two 115/50-kV or 230/50-kV single-phase transformers, both of which would be rated at 60 megavolt-amperes. The autotransformer feed system would step down the transmission voltage to 50 kV (phase-to-phase), with 25 kV (phase-to-ground) to power the traction power distribution system. TPSSs would require a buffer area for safety purposes. The TPSSs and associated feeder gantries (Figure 2-25) could be screened from view with a perimeter wall or fence. Each TPSS site would have a 20-foot-wide access road (or easement) from the street access point to the protective fence perimeter at each parcel location. Each site would require a parcel of up to 2 acres. Each TPSS would include an approximately 450-square-foot (18- by 25-foot) control room.

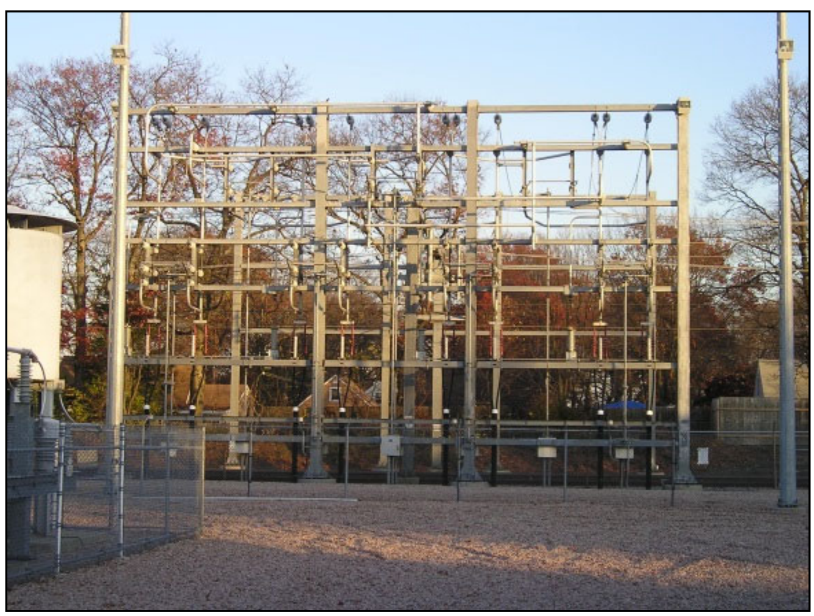


Figure 2-25 Traction Power Substation Overhead Contact System Gantry

2.3.7.2 *Traction Switching and Paralleling Stations*

Traction power switching and paralleling stations work together to balance the electrical load between tracks and to switch power off or on to either track in an emergency. Traction power switching stations (Figure 2-26) would be required at approximately 15-mile intervals, midway between the switching stations. Each traction power switching station would encompass approximately 14,400 square feet (160 by 90 feet).

Figure 2-26 Switching Station

Traction power paralleling stations (Figure 2-27 and Figure 2-28) would be required at approximately 5-mile intervals between the traction power substations and the switching stations. Each traction power paralleling station would encompass approximately 9,600 square feet (120 by 80 feet) and include an approximately 450-square-foot (18- by 25-foot) control room.

Figure 2-27 Paralleling Station

Figure 2-28 Paralleling Station Overhead Contact System Gantry

The traction power switching and paralleling stations and associated feeder gantries could be screened from view with a perimeter wall or fence.

2.3.7.3 Backup and Emergency Power Supply Sources for Stations and Facilities

During normal system operations, the local utility would provide power service through the TPSS. Should the flow of power be interrupted, the system would automatically switch to a backup power source through use of an emergency standby generator, an uninterruptable power supply, or a direct-current battery system.

Permanent emergency standby generators for the HSR system are anticipated to be located at maintenance facilities. These standby generators must be tested (typically once per month) in accordance with National Fire Protection Association 110/111 to ensure their readiness for backup and emergency use. If needed, portable generators could also be transported to other trackside facilities to reduce the impact on system operations.

2.3.7.4 Electrical Interconnections

As described above, each TPSS would have two 115/50-kV or 230/50-kV single-phase transformers. These transformers would interconnect the TPSS to two breaker-and-a-half bays,[3] built at a new utility switching station within the fence line of an existing utility facility via a short section of 230-kV transmission or 115-kV power lines (tie-lines). Per Authority requirements, the proposed interconnection points would need redundant transmission (i.e., double-circuit electrical lines) from the point of interconnection, with each interconnection connected only to two phases of the transmission source. A new utility switching station would encompass approximately 32,200 square feet (160 by 220 feet) and include an approximately 975-square-foot (15- by 65-foot) control building, a 525-square-foot (15- by 35-foot) battery building, and, if required, a retention basin. The utility switching station could be screened from view with perimeter walls or fences.

2.3.7.5 Network Upgrades

The Authority has coordinated with Pacific Gas and Electric Company and Southern California Edison and determined that network upgrades would be required to meet the projected power demands of the 345-mile portion of the HSR system located within their respective service

[3] A breaker and a half is a common design of overlapping circuits and circuit breakers to provide system reliability.

territories. The *Bakersfield to Palmdale Project Section: Supplemental Alternatives Analysis Report* (Authority 2016a) documents the Authority's coordination efforts. The Authority has developed conceptual locations for electrical interconnections along the HSR alignment. Electric power utility improvements as designed, including construction and permanent maintenance easements, are included in the project footprint and are evaluated as part of the project in this EIR/EIS. Detailed engineering of electrical interconnections and network upgrade components will be completed closer to the start of construction. Network upgrades could include modifications to existing infrastructure such as expansion of existing substations and reconductoring of existing electrical lines (i.e., replacement of power structures [poles and lattice steel towers] and electrical conductors with taller structures and more efficient electrical wires or new electrical lines). All network upgrades would be implemented pursuant to California Public Utilities Commission General Order 131-D.

2.3.8 Signaling and Train-Control Elements

A computer-based, enhanced ATC system would control the trains. The enhanced ATC system would comply with FRA-mandated positive train control requirements, including safe separation of trains, over-speed prevention, and work-zone protection. The system would use a radio-based communications network that would include a fiber-optic backbone and communications towers at intervals of approximately 3 miles or less, depending on the terrain selected, radio frequency, and locations of other facilities. Signaling and train control elements within the right-of-way would include 18- by 15-foot communications shelters or signal huts/bungalows that house signal relay components and microprocessor components, cabling to the field hardware and track, signals, and switch machines on the track. Train control facilities ranging from 2,450 square feet (70 by 35 feet) to 7,175 square feet (110 by 65 feet) would be located along the track. Communications towers within these facilities would use a 6- to 8-foot-diameter, 100-foot-tall pole. The communications facilities would be located in the vicinity of track switches and would be grouped with other traction power, maintenance, station, and similar HSR facilities where possible. Where communications towers cannot be located with TPSSs or other HSR facilities, the communications facilities would be located near the HSR corridor in a fenced area of approximately 40 feet by 25 feet. Figure 2-29 illustrates a radio tower site.

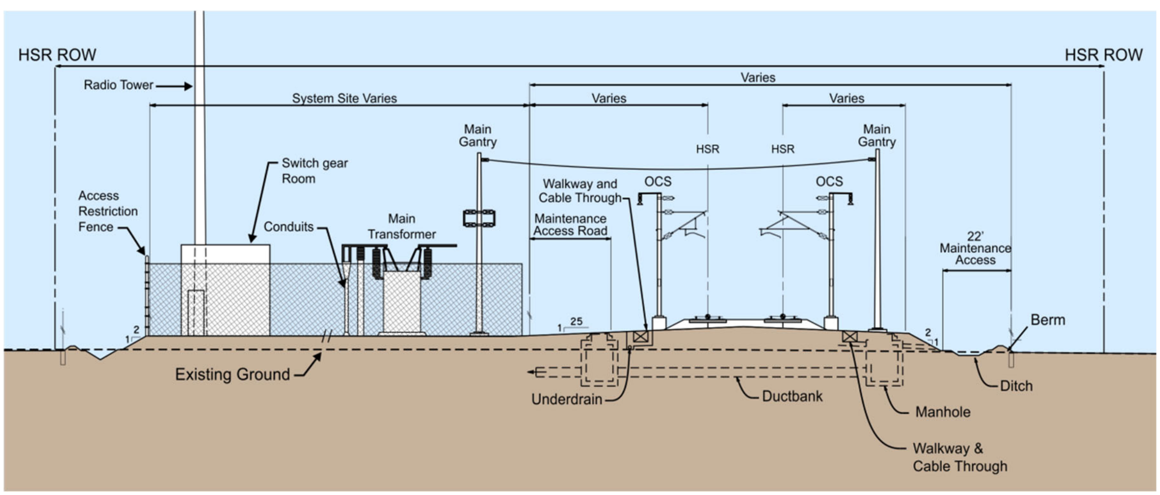


Figure 2-29 Typical Cross Section of At-Grade Profile with Traction Power, Signaling, and Train-Control Features

2.3.9 Track Structure

The track structure would consist of either a direct fixation system (with track, rail fasteners, and slab) or ballasted track, depending on local conditions and decisions to be made in later design. Ballasted track requires more frequent maintenance than slab track, as described below, but is less expensive to install.

For purposes of environmental review, slab track is assumed for long HSR structures and ballasted track is assumed for surface sections. The analyses in the environmental review documents assume that direct fixation would be used for track supported by structures longer than 1,000 feet, while ballast would be used for track supported by earthwork or structures shorter than 1,000 feet. A subsequent environmental review would be performed if there is a significant change in the type of track structure following additional design and technical review.

2.3.10 Maintenance Facilities

The California HSR System includes four types of maintenance facilities: maintenance-of-way facilities (MOWF), maintenance of infrastructure siding facilities (MOIS), heavy maintenance facilities (HMF), and light maintenance facilities (LMF). The California HSR System would require one HMF for the system, which would not be located within the Bakersfield to Palmdale Project Section.[4] The design and spacing of maintenance facilities along the HSR alignment would require the Bakersfield to Palmdale Project Section to include three maintenance facilities (an MOWF and two MOIS) plus an option for an LMF facility in the Antelope Valley. (If the Bakersfield to Palmdale Project Section were to be built and operated independently, then the LMF in the Antelope Valley would be required.) Potential sites for the LMF and MOWF, as well as for a co-located LMF/MOWF, are situated in the Antelope Valley. The two MOIS facilities are anticipated to be located in Edison and Tehachapi. The Authority's decision on the optimum location of an LMF and MOWF is expected to be based on the following factors:

- Consistency with local plans and policies
- Minimization of environmental and socioeconomic impacts
- Operational considerations and costs

The description and evaluation of the prospective sites for an LMF, MOWF, and co-located LMF/MOWF are discussed in Section 2.5.2.2, Overview and Summary of Design Features). The LMF is the same as what was previously called the Terminal Storage Maintenance Facility in the 2016 SAA.

2.3.10.1 Maintenance-of-Way Facility

The HSR infrastructure would be maintained from regional MOWFs located no more than 150 miles apart. MOWFs would be outfitted to support the maintenance of infrastructure requirements for approximately 50 to 75 miles in either direction. For example, the MOWF located within the Bakersfield to Palmdale Project Section would support maintenance activities for tunnels and high viaducts. The MOWFs would provide regional maintenance machinery servicing storage, materials storage, personnel, and maintenance and administration (Authority 2016c).

As defined in the *Summary of Requirements for Maintenance Facilities* (Appendix 2-F), the functional requirements of the MOWF sites include:

- Six yard tracks plus one siding track (1,600 feet)
- Approximately 8,150 feet of yard track capacity
- Shop facilities for the following activities: maintenance and repair of maintenance of infrastructure inventory and equipment
- Stockpile areas for ballast and other bulk materials
- Secured stockpile areas for nonbulk materials
- A rail-side unloading dock and continuously welded rail train storage (1,600 feet)
- Rail-borne equipment and locomotive storage tracks
- Road-rail vehicle access locations

[4] The Authority and FRA have evaluated a number of HMF sites in the Central Valley in the Merced to Fresno and Fresno to Bakersfield Project Section EIR/EISs but have not yet made a decision on which one to use.

The MOWFs could be co-located with the nearest HMF or LMF in order to consolidate HSR resources and minimize community impacts. Effective connectivity to the highway road network and access to utilities, including water, gas, electricity, sewer, and communications, would also be required. MOWF facilities are estimated to be approximately 30 acres in size, inclusive of roadways and parking (Authority 2016c).

Figure 2-30 shows a conceptual MOWF layout.

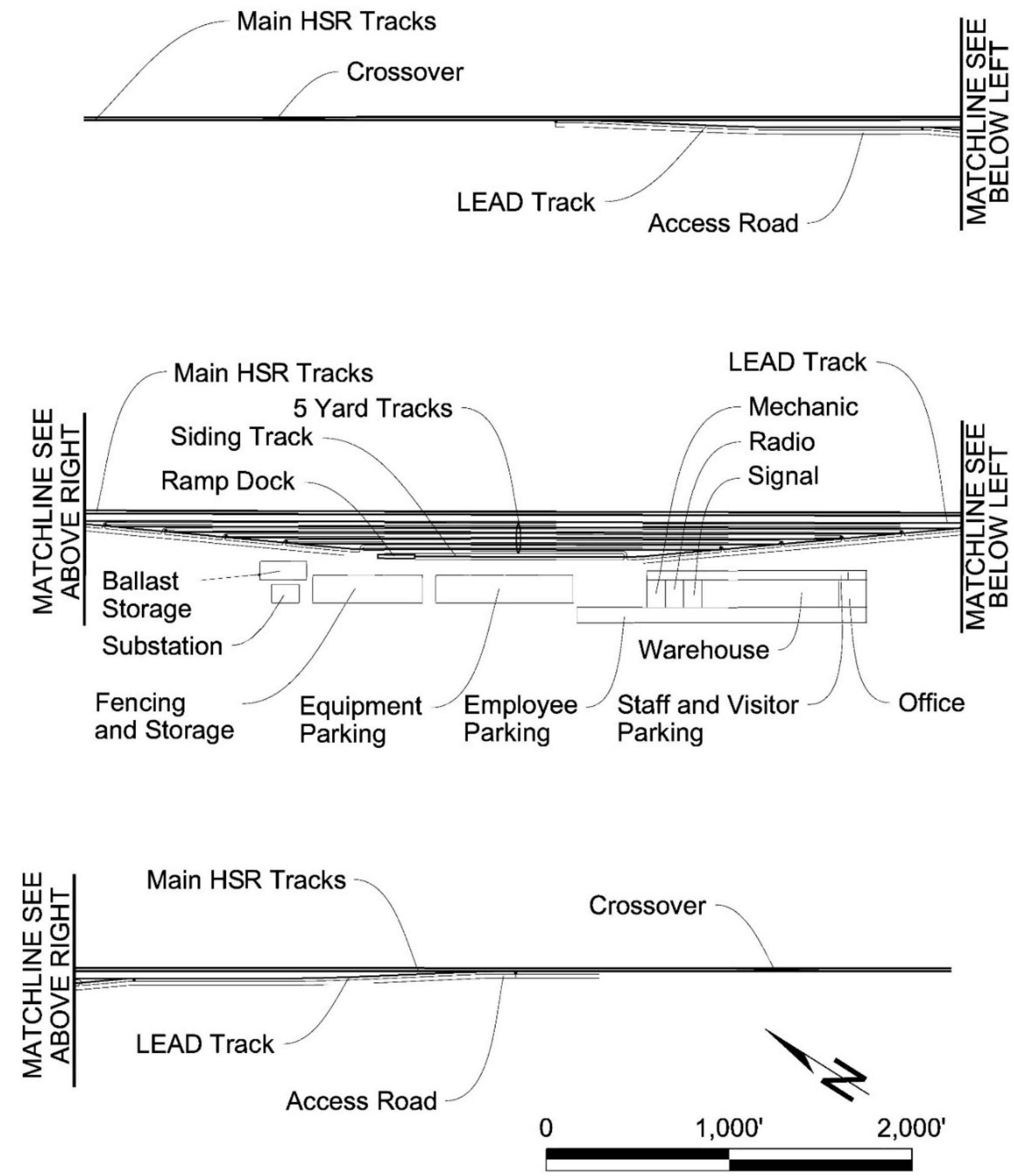


Figure 2-30 Typical Maintenance-of-Way Facility Layout

2.3.10.2 Light Maintenance Facility

The LMF site would be sized to support the level of daily service dispatched by the nearby terminal at the start of each revenue service day. The Authority defines three levels of maintenance that can be performed at an LMF (Appendix 2-F):

- Level I: Daily inspections, including pre-departure cleaning and testing
- Level II: Monthly inspections
- Level III: Quarterly inspections, including wheel-truing

The Bakersfield to Palmdale Project Section would require a total of 29 facility tracks (21 yard tracks and 8 shop tracks). LMFs require yard tracks, capable of holding two complete trainsets, plus two runaround/transfer tracks to move from one end of the facility to the other and shop tracks designed to accommodate a minimum of one trainset each. The Bakersfield to Palmdale Project Section LMF would also include train wash and wheel defect detection facilities (Appendix 2-F).

As defined in the *Summary of Requirements for Maintenance Facilities* (Appendix 2-F), the recommended LMF configuration includes:

- Direct main track access achieved through double-ended yard leads to facilitate movements both north and south without changing direction
- Grade-separated flyovers to access the main track
- 60 mph interlockings[5] with universal crossovers at the main tracks (on both ends, immediately adjacent to the main track turnouts)
- 1,700-foot transition tracks to reduce/increase speed to/from stop and to transition to the ATC system

The result is a total estimated length of about 7,500 feet (not including transition tracks) with a width dependent on the number of tracks required at each facility. An LMF would require approximately 40 to 110 acres. Note that other LMF configurations could be considered on a case-by-case basis, depending on the proposed location of a site relative to the nearest station and the operational details of the service plan.

Other facilities that could be co-located with an LMF include an MOWF. Locating these facilities as an integral part of, or adjacent to, the LMF could facilitate better coordination and utilization of operations systems and assets while also potentially reducing the overall footprint required for the facilities. Locating these facilities away from the LMF would not necessarily introduce negative impacts that could not be effectively managed/mitigated. Figure 2-31 shows a conceptual double-ended LMF layout.

2.3.10.3 Maintenance of Infrastructure Sidings

MOIS facilities would support MOWF activities by providing a location for layover of maintenance of infrastructure equipment and temporary storage of materials. The MOIS facilities would be centrally located within the 50- to 75-mile maintenance sections on either side of an MOWF. More than one location may be required in some maintenance sections as a result of difficult terrain, such as the Tehachapi Mountains. Within the Bakersfield to Palmdale Project Section, an MOIS is proposed in Edison near the bottom of the Tehachapi Mountains and also in Tehachapi near the top of the Tehachapi Mountains. The MOIS facilities are estimated to be approximately 5 acres in size.

As defined in the *Summary of Requirements for Maintenance Facilities* (Authority 2016c), the functional requirements of the MOIS sites include:

- One siding track (1,600 feet)
- One tail track (200 feet)
- Stockpile areas for ballast and other bulk materials
- Secured stockpile areas for nonbulk materials
- Road-rail vehicle access locations

[5] Interlockings are signaling equipment that control safe train movement and prevent conflicting movements at junctions or crossings.

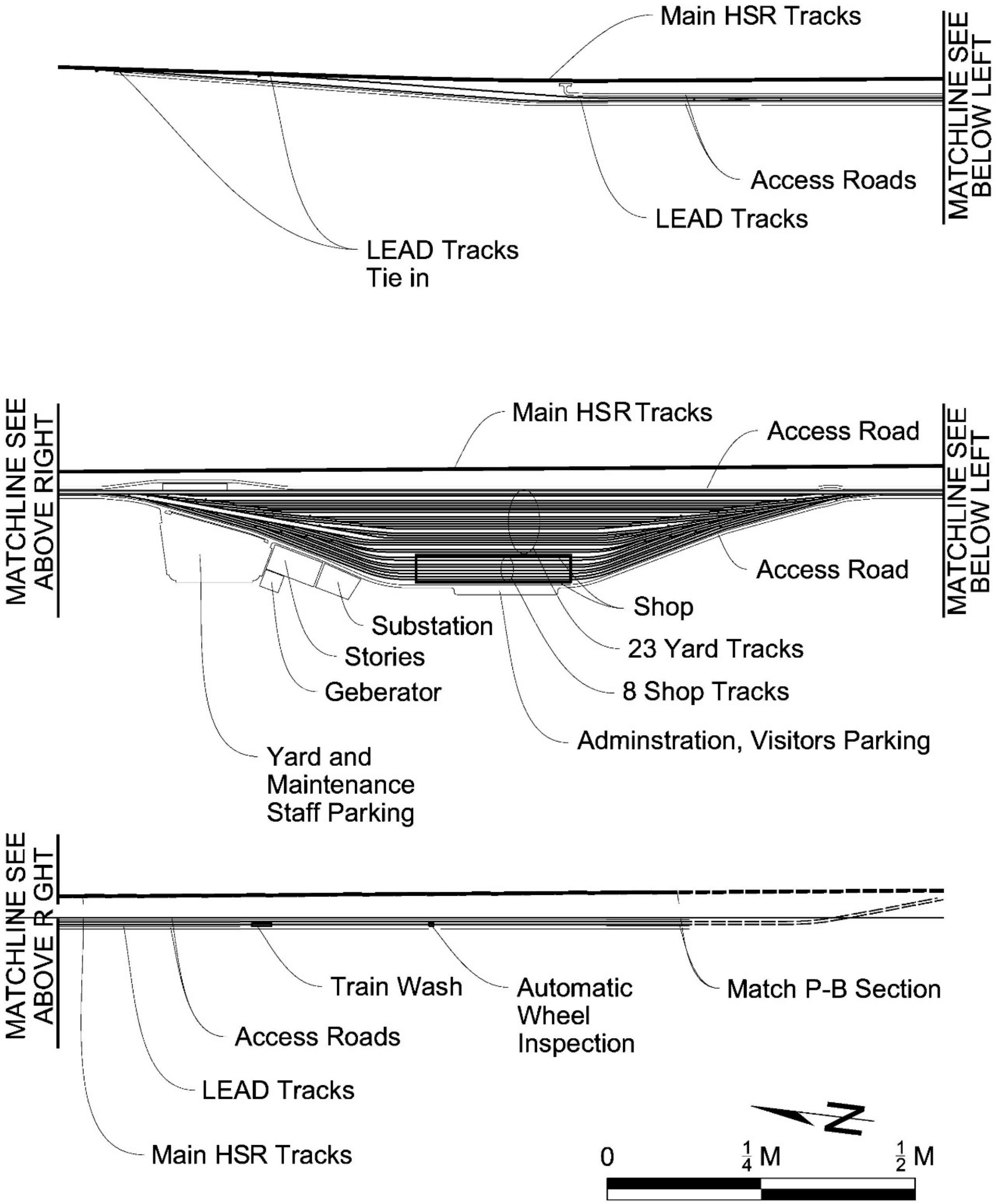


Figure 2-31 Typical Double-Ended Light Maintenance Facility Layout Alternatives Considered during Alternatives Screening Process

2.3.11 High-Speed Rail Project-Level Alternatives Development Process

Following the decisions of the program EIR/EIS documents (Section 1.1.2, The Decision to Develop a Statewide High-Speed Rail System), the Authority, in cooperation with the FRA, began the environmental review process for the Bakersfield to Palmdale Project Section of the California HSR System. The environmental review process for the Bakersfield to Palmdale Project Section commenced in 2009 with a Notice of Intent (published on September 4, 2009) and a Notice of Preparation, as well as an agency and public scoping process. Public and agency comments received during the Bakersfield to Palmdale Project Section Project EIR/EIS scoping period and through interagency coordination meetings also informed the development of initial alternatives for the screening evaluation. After analysts identified the initial group of potential alternatives, they developed alignment plans, preliminary profile concepts, and cross sections.

The Bakersfield to Palmdale Project Section is in one of the most seismically active areas in the U.S., crossing major active fault zones. Thus, geology-related risks are of particular concern in this region and were considered during development of the alignment alternatives. HSR design criteria (found in *Alignment Design Standards for High-Speed Train Operation TM 2.1.2* [Authority 2009b] on the Authority's website), summarized in Section 2.3.1 and Table 2-1 of this EIR/EIS, generally require 250 mph designs throughout with limitations on grades and design capable of a sustained vertical gradient of 2.5 percent without considerable degradation in performance. The Bakersfield to Palmdale Project Section track grades vary from 0 to 2.8 percent, with the maximum grade occurring in the Tehachapi Mountains. The Bakersfield to Palmdale Project Section would require a variance for criteria because it has exceptional grades (above 2.5 percent) and would exceed the limitation on length of steep grades (the average grade for any 6.2-mile-long section of the line shall be under 2.5 percent).

The Bakersfield to Palmdale Project Section is also one of the HSR project sections with sites under consideration for the LMF, where the trains would be stored, serviced, and inspected for daily revenue service. The following sections summarize the Bakersfield to Palmdale Project Section alternatives development and analysis process and results.

An EIR/EIS is required to analyze the potential impacts of a reasonable range of alternatives (California Code of Regulations Title 14, Section 15126.6; 40 C.F.R. 1502.14(a)).[6] Under CEQA, the alternatives are to include a No Project Alternative and a range of potentially feasible alternatives that would (1) meet most of the project's basic objectives and (2) avoid or substantially lessen one or more of the project's significant adverse effects (California Code of Regulations Title 14, Section 15126.6(c)). In determining the alternatives to be examined in the EIR, the lead agency must describe its reasons for excluding other potential alternatives. There is no ironclad rule governing the range of alternatives to be studied in an EIR other than the "rule of reason." Under the "rule of reason," an EIR is required to study a sufficient range of alternatives in order to permit a reasoned choice (California Code of Regulations Title 14, Section 15126.6(f)). CEQA does not require that all possible alternatives be studied.

Alternatives Analysis Reports Available for Public Review

Information about accessibility of the Alternatives Analysis, including the preliminary and supplemental reports, is available on request form the Authority at records@hsr.ca.gov.

Under NEPA, an EIR/EIS is required to analyze a reasonable range of alternatives to the proposed action as well as the No Action Alternative. (40 C.F.R. 1502.14). Pursuant to Section 14(l) of the FRA's *Procedures for Considering Environmental Impacts* (FRA 1999), these include "all reasonable alternative courses of action that could satisfy the [project's] purpose and need"

[6] The Council on Environmental Quality issued new regulations on July 14, 2020, effective September 14, 2020, updating the NEPA implementing procedures at 40 C.F.R. 1500. However, this project initiated NEPA before the effective date and is not subject to the new regulations, relying on the 1978 regulations as they existed prior to September 14, 2020. All subsequent citations to Council on Environmental Quality regulations in this environmental document refer to the 1978 regulations, pursuant to 40 C.F.R. 1506.13 (2020) and the preamble at 85 Fed. Reg. 43340.

(*Federal Register* Volume 64, Page 28546). There is no minimum number of alternatives that must be considered in an EIS.

The development of project-level alternatives followed the process described in the *Bakersfield to Palmdale Preliminary Alternatives Analysis Report* (Authority 2010c). The assessment of potential alternatives involved both qualitative and quantitative measures that address applicable policy and technical considerations. These included the following:

- Field inspections of corridors
- Project team input and review considering local issues that could affect alignments
- Agency and stakeholder input and review
- Qualitative assessment of constructability, accessibility, operations, maintenance, right-of-way, public infrastructure impacts, railway infrastructure impacts, and environmental impacts
- Engineering assessment of project length, travel time, and configuration of key features of the alignment, such as the presence of existing infrastructure
- Geographic information system-based analysis of impacts on farmland, water resources, wetlands, threatened and endangered species, cultural resources, current urban development, and infrastructure

The potential alternatives were evaluated against the HSR system screening criteria (travel time, route length, intermodal connections, capital costs, operating costs, and maintenance costs). Screening also included environmental criteria to measure the potential effects of the proposed alternatives on the natural and human environment. The land use criteria measured the extent to which a station alternative supports transit use; is consistent with existing adopted local, regional, and state plans; and is supported by existing and future growth areas. Constructability measured the feasibility of construction and the extent to which right-of-way is obtainable or constrained. Community impacts measured the extent of disruption to neighborhoods and communities, such as potential to minimize (1) right-of-way acquisitions, (2) dividing an established community, and (3) conflicts with community resources. Environmental resources and quality measured the extent to which an alternative minimizes impacts on natural resources and human environment, including parklands and cultural resources, as well as noise effects and changes in visual quality.

2.3.11.1 Project Definition Framework and Alternatives Development

HSR project definition begins with the corridor(s) and station locations selected by the Authority and FRA in the Statewide Program EIR/EIS (Authority and FRA 2005) and the Bay Area to Central Valley Program EIR/EIS (Authority and FRA 2008) (as applicable) and concludes with identification of the preferred HSR project alternative. Project definition becomes increasingly detailed to meet the analytical and decision-making needs at progressive stages of the CEQA/NEPA and NEPA/404/408 Integration processes. Project definition requires developing information of sufficient type, detail, and precision, and incorporating adequate agency, stakeholder, landowner, and public engagement, to achieve timely, efficient, and cost-effective project information at each process stage. Resources were administered to minimize, to the extent feasible, investment in excess of process stage requirements or effort that would not contribute to subsequent stages in the process.

2.3.12 Range of Potential Alternatives Considered and Findings

This section explains how the alternatives were developed, taking into account alignment and station development considerations in both Bakersfield and Palmdale. The alternatives analysis process evaluated design options within individual alternatives in order to isolate concerns and to screen and refine the overall alternative to avoid key environmental issues or improve performance. The alternatives that were not carried forward had greater direct and indirect environmental impacts, were impracticable, or failed to meet the project purpose. Alternatives included in the PAA (Authority 2010c) are discussed in more detail below. Additional information on alternatives preliminarily considered but not carried forward for full evaluation in this EIR/EIS can be found in the PAA (Authority 2010c), the 2012 SAA (Authority 2012a, 2012b), and the 2016 SAA and ASM (Authority 2016a).

While the alternatives analysis process considered multiple criteria, the project objective to maximize the use of existing transportation corridors and available rights-of-way to the extent feasible was emphasized as a method of minimizing impacts caused by creating an entirely new linear transportation corridor. Additionally, the engineering, geologic, and grade-requirement challenges within this project section have influenced the alternative alignments during the alternatives analysis process. The following sections summarize the alternatives included in the Statewide Program EIR/EIS, PAA, and SAA reports.

2.3.12.1 Statewide Program EIR/EIS

In the 2005 Statewide Program EIR/EIS, the Authority and FRA defined a broad corridor between Bakersfield and Los Angeles, which was further divided into two segments: (1) Bakersfield to Sylmar and (2) Sylmar to Los Angeles (Figure 2-32).

The screening evaluation conducted as part of the Statewide Program EIR/EIS considered six general alignment corridors for the Bakersfield to Sylmar segment:

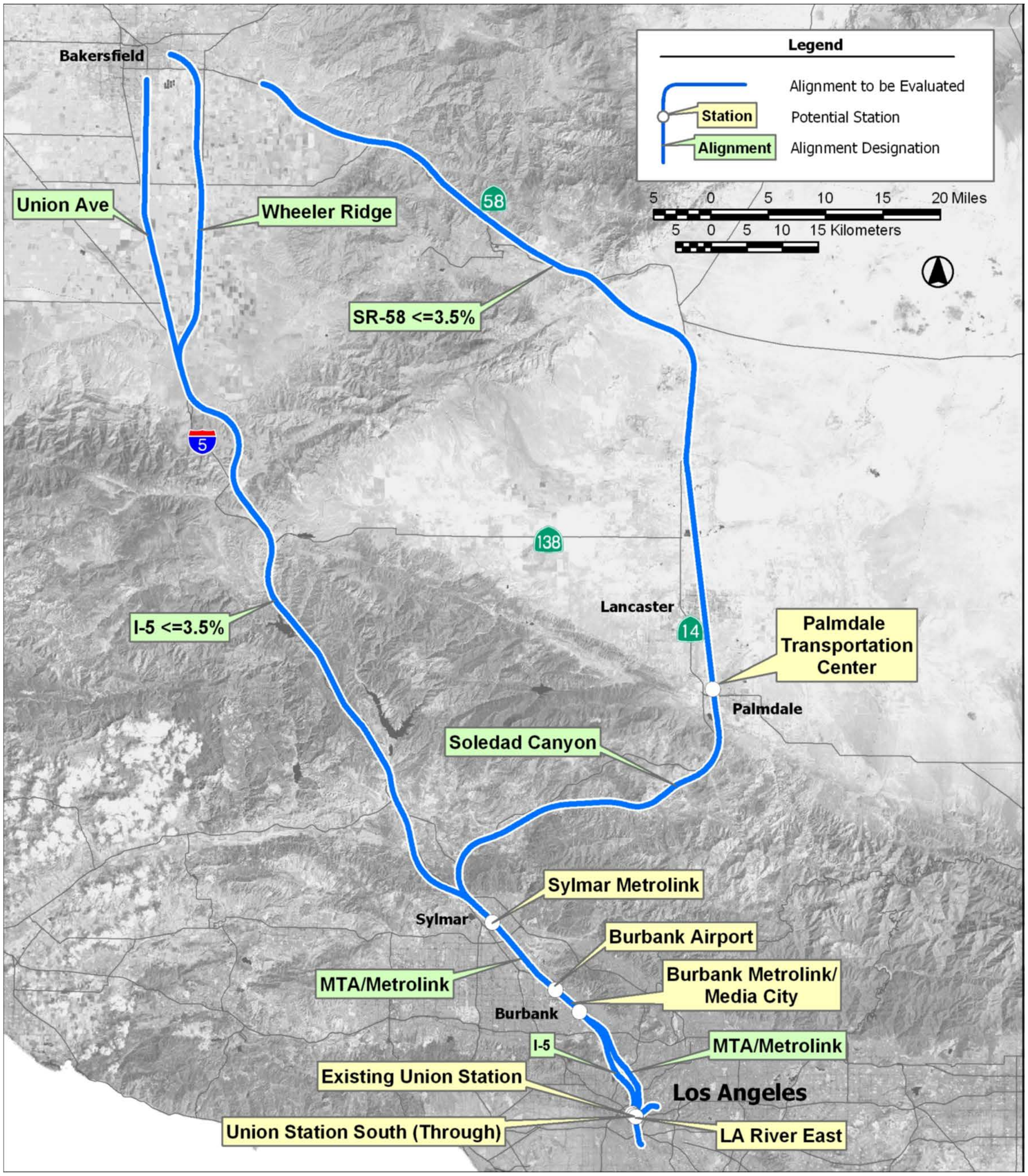
- SR 138 (Soledad Canyon or SR 14)
- Aqueduct (Soledad Canyon or SR 14)
- Interstate (I) 5 via Comanche Point
- I-5 (2.5 percent maximum grade) (Union Avenue or Wheeler Ridge)
- I-5 (3.5 percent maximum grade) (Union Avenue or Wheeler Ridge)
- SR 58/Soledad Canyon

As a result of the screening evaluation, the SR 138, Aqueduct, I-5 via Comanche Point, and I-5 (2.5 percent maximum grade) corridors were eliminated from study in the Statewide Program EIR/EIS. These alignments were eliminated based on seismic constraints, as each would require long tunnels through seismic zones, either crossing active faults or paralleling them for long distances. Of the remaining alignments, the SR 58/Soledad Canyon Corridor (Antelope Valley) was identified as the Preferred Alignment because it would have fewer potential environmental impacts, be less subject to seismic activity, and have considerably less tunneling (and thus fewer constructability issues and lower construction costs) than the I-5 (3.5 percent maximum grade) alignment options (i.e., Union Avenue or Wheeler Ridge). Figure 2-33 illustrates the alignments considered in the Statewide Program EIR/EIS (Authority and FRA 2005) and the FRA Record of Decision (FRA 2005).

Key Environmental Factors in the PAA and SAA Analysis

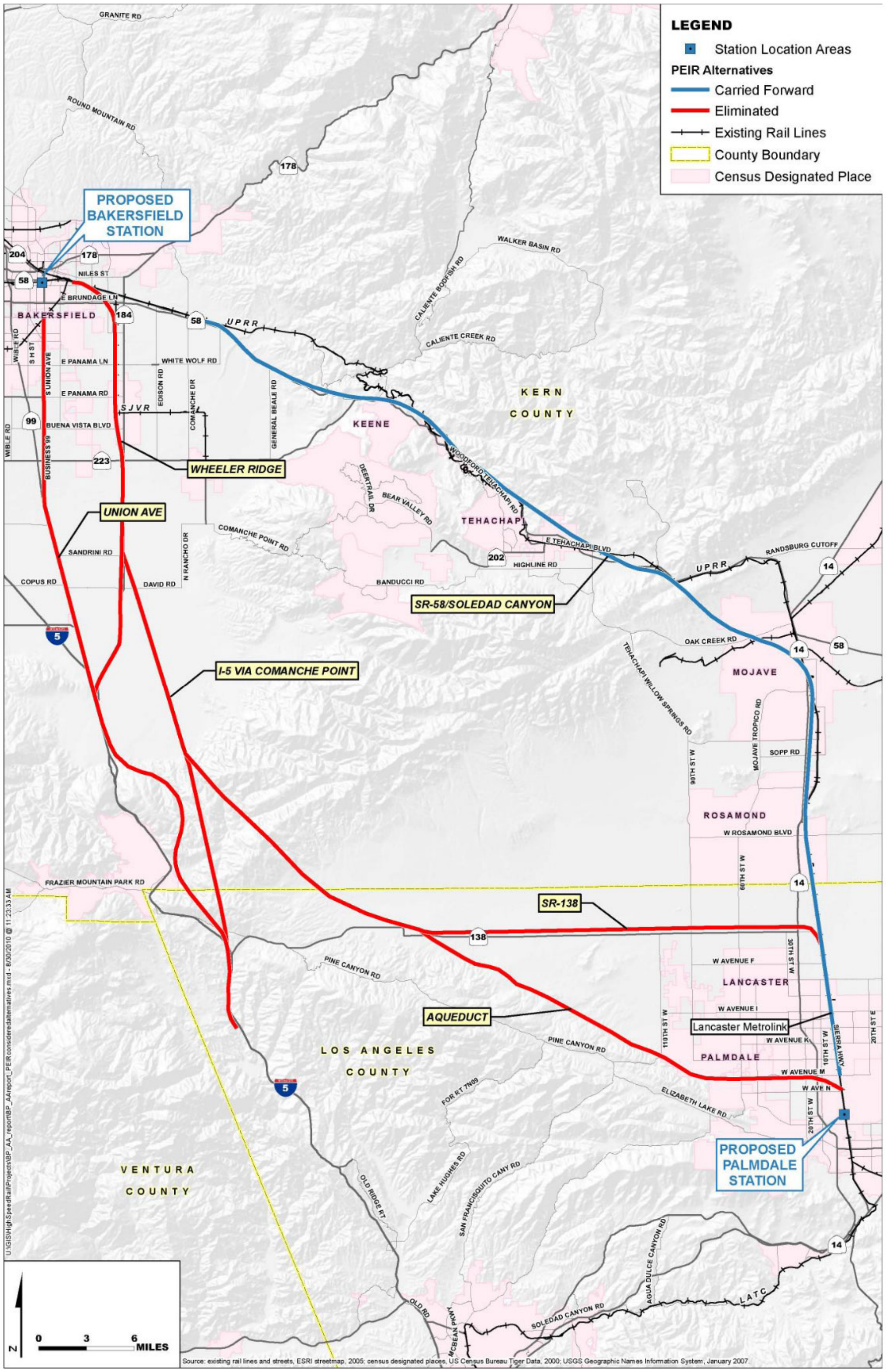
The PAA/SAA review considered all of the following factors:

- System factors: journey time, rail length, intermodal connections, costs
- Constructability: feasibility, disruption to existing railroads and utilities
- Endangered and threatened species: effects on habitat for state- and federally listed plant and wildlife species
- Farmland: effects on designated Important Farmland
- Flood control: effects on floodplains
- Cultural resources: effects on archaeological sites and historic buildings and structures
- Geological constraints
- Land use: consistency with local planning
- Noise-sensitive receptors near the alignment
- Parks and open space: effects on publicly owned parks, recreational areas, and wildlife areas per Section 4(f) of the 1966 Department of Transportation Act
- Residential/commercial: potential displacement of residences and businesses
- Schools in close proximity
- Traffic impacts and road closures
- Visual/scenic resources
- Waters/wetlands: impacts on state and federal waters



Source: California High-Speed Rail Authority and Federal Railroad Administration, 2005

Figure 2-32 Bakersfield to Los Angeles Corridor Alignments and Stations Carried Forward (2005 Statewide Program EIR/EIS)



Source: California High-Speed Rail Authority, 2010b
The "Carried Forward" blue line is the Statewide Program EIR Alternative carried forward as the Preferred Alternative for further Tier 2 study.

Figure 2-33 2005 Statewide Program EIR/EIS Alignments Considered

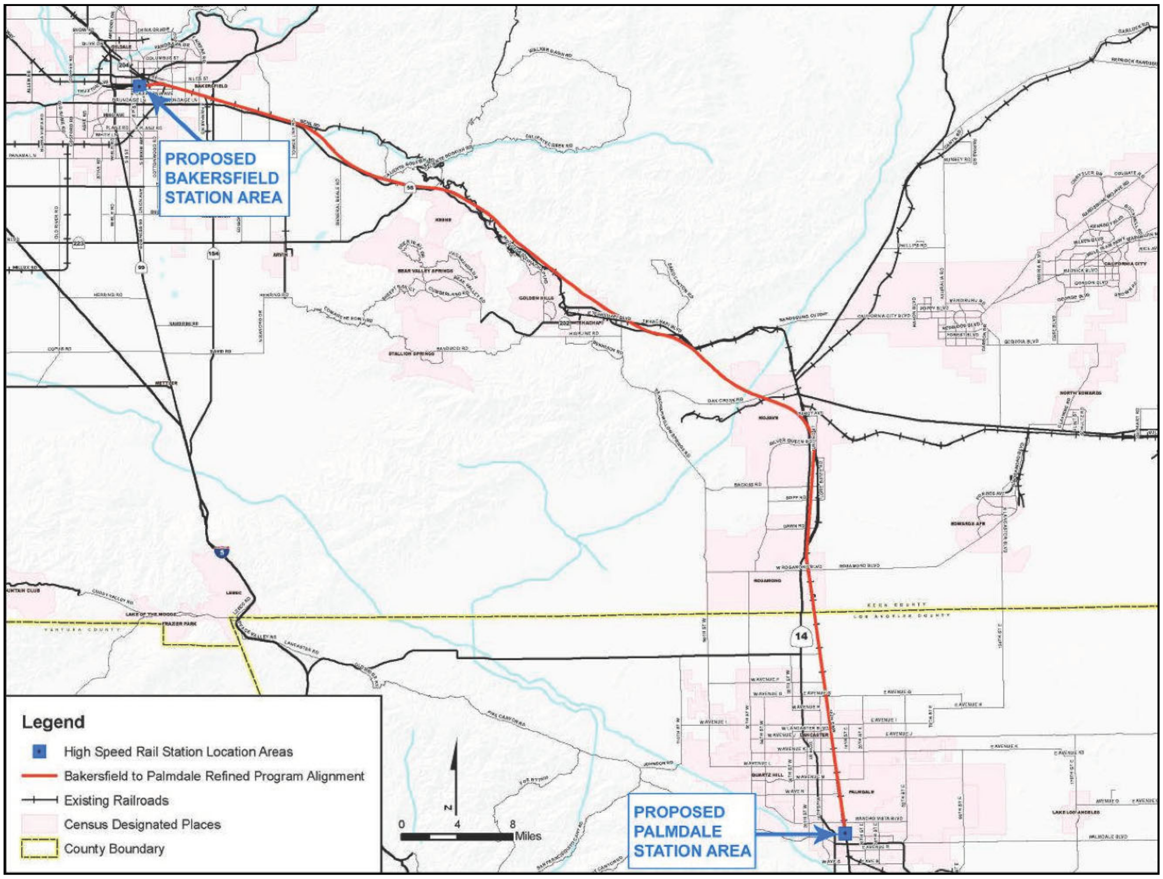
Based on the Statewide Program EIR/EIS, the Authority and FRA selected the SR 58/Soledad Canyon Corridor (Antelope Valley) to advance for further Tier 2 (project-level) study, with stations in Palmdale and Sylmar (Authority 2005; FRA 2005). The SR 58/Soledad Canyon Corridor was selected over the I-5 Corridor because although the longer Antelope Valley alignment would add about 10 minutes to express service travel times between Northern and Southern California and would have less intercity ridership (trips between regions) potential than the I-5 alignment option, it would have fewer potential environmental impacts, be less subject to seismic activity, and have considerably less tunneling. Therefore, the SR 58/Soledad Canyon Corridor would have fewer constructability issues and would more effectively increase connectivity and accessibility.

The Antelope Valley alignment is estimated to have more potential to have impacts on cultural resources than the I-5 alignment options and slightly more potential for impacts on biological resources. However, the Antelope Valley alignment would have a lower overall potential for water-related impacts because the potential impacts are related to the relatively small seasonal streams in Soledad Canyon and the alignment would not encroach on any lakes. The Antelope Valley option would also have fewer potential impacts on wetlands and nonwetland waters than the I-5 options. In addition, the Antelope Valley option was forecast to have fewer growth-inducing impacts on urbanized land and farmland conversion than the I-5 options because the I-5 options would result in more growth in the Central Valley. The most significant difference with regard to potential environmental impacts between the Antelope Valley option and I-5 alignments is related to major parklands. The Antelope Valley alignment would not go through major parks. In contrast, the I-5 options would potentially affect Fort Tejon Historic Park, the Angeles and Los Padres National Forests, the Hungry Valley State Vehicular Recreation Area, Pyramid Lake, and other local parks.

The Antelope Valley alignment traverses less challenging terrain than the I-5 options, which would result in considerably less tunneling overall (13 miles of tunneling for the Antelope Valley option versus 23 miles for the I-5 options), and considerably shorter tunnels (maximum length of 3.4 miles for the Antelope Valley option versus two tunnels greater than 5 miles for the I-5 options), which would result in fewer constructability issues. Although the Antelope Valley option is about 35 miles longer than the I-5 alignment options, it would be slightly less expensive to construct as a result of less tunneling through the Tehachapi Mountains. In addition, due to its gentler gradient, geology, topology, and other features, the SR 58/Soledad Canyon Corridor offers greater opportunities for using potential HSR alignment variations, particularly through the mountainous areas of the corridor, to avoid impacts on environmental resources. In contrast, the more challenging terrain of the I-5 corridor greatly limits the ability to avoid sensitive resources and seismic constraints.

2.3.12.2 2009 NEPA/CEQA Scoping

After dividing the HSR system into individual “project sections” for further environmental review, project-level studies for the Bakersfield to Palmdale Project Section were initiated in 2007. On August 24, 2009, the Authority distributed a Notice of Preparation of an EIR for the Bakersfield to Palmdale Project Section. The FRA also published a Notice of Intent in the *Federal Register* on September 4, 2009, announcing the preparation of an EIS for the Bakersfield to Palmdale Project Section. In response to the Notice of Preparation/Notice of Intent, public agencies with legal jurisdiction were requested to advise the Authority and the FRA of the applicable permit and environmental review requirements of each agency, as well as the scope and content of the environmental information that is germane to the agency’s statutory responsibilities in connection with the proposed project. Public scoping meetings were scheduled as an important component of the scoping process for both the state and federal environmental review. Figure 2-34 illustrates the preferred corridor identified in the Statewide Program EIR/EIS. The Authority then conducted scoping meetings in Bakersfield, Tehachapi, and Palmdale in mid-September 2009. The Authority and FRA received 50 written comments from individuals and organizations (i.e., comment cards, emails, and transcriptions), 15 comments from agencies, and 2 comments from private businesses concerning potential project-level alternatives and environmental effects.



Source: California High-Speed Rail Authority, 2009e

Figure 2-34 Statewide Program EIR/EIS—Preferred Alignment

The *Bakersfield to Palmdale Scoping Report* (Authority 2009f) summarizes the issues identified and describes the comments regarding the proposed alignments for study. Major issues identified as a result of scoping are listed below:

- Agricultural impacts
- Air quality impacts
- Natural resources impacts
- Earthquake (seismic concerns)
- Floodplain impacts
- Land use impacts
- Noise impacts
- Recreation impacts
- Parking and transit connections at stations

The Authority and FRA have engaged in extensive consultation with National Chávez Center representatives and evaluated the project's potential effects on La Paz. This consultation continues as design refinements are made to further reduce or avoid potential effects. By 2010, when the project alignments were being developed and refined, La Paz was considered in compliance with Section 106. By that point, it had been identified as a high-profile property, was being considered for National Historic Landmark designation, and had already been identified as eligible for listing on the National Register of Historic Places. The property's eligibility for listing, by itself, required consideration under Section 106 long before the property's designation as a National Monument.

2.3.12.3 2010 Preliminary Alternatives Analysis Report

The 2010 PAA (Authority 2010b) for the Bakersfield to Palmdale Project Section identifies feasible and practicable HSR study alternatives to carry forward for environmental review and evaluation in the Draft EIR/EIS under CEQA and NEPA. The 2010 PAA divides the Bakersfield to Palmdale Project Section into three subsections: Edison, Tehachapi, and Antelope Valley. Figure 2-35 (taken from the PAA) illustrates the three identified subsections. For each subsection of the Bakersfield to Palmdale Project Section, the Authority conducted agency and community outreach to help identify alternatives for further development as part of the project-level environmental review process. An initial evaluation of alternatives was conducted to narrow the range of alternatives to be evaluated in detail, resulting in four alternatives in the Edison Subsection, four alternatives in the Tehachapi Subsection, and five alternatives in the Antelope Valley Subsection. Figure 2-36, Figure 2-37, Figure 2-38, and Figure 2-39 illustrate the alignment alternatives for each of the subsections. These initial alternatives were based on the SR 58/ Soledad Canyon Corridor selected in 2005 and alternatives proposed during public scoping. With the exception of the Tehachapi Subsection, all alternatives considered in the Bakersfield to Palmdale Project Section generally parallel the path of the Statewide Program EIR/EIS Preferred Alignment.

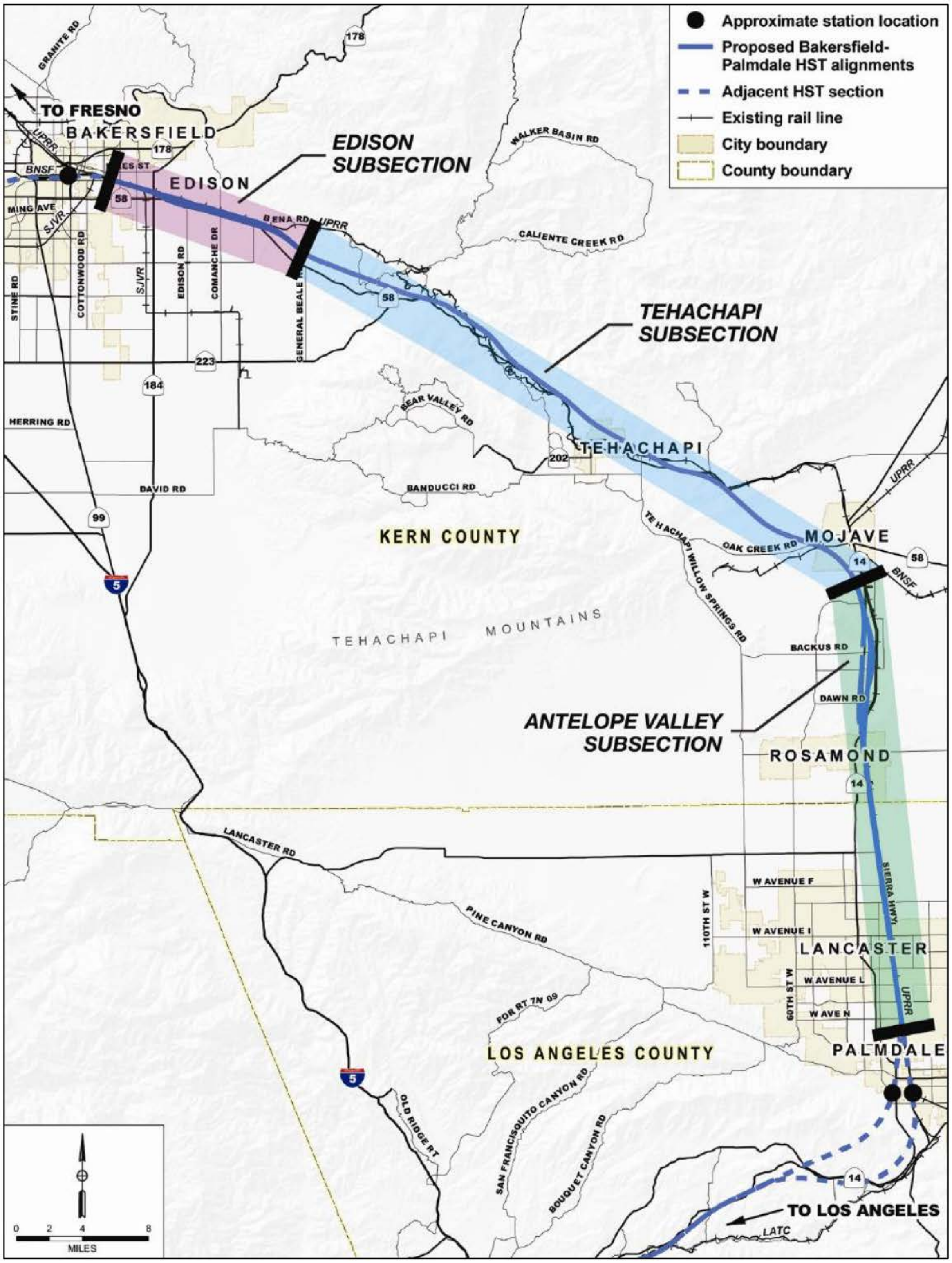
Quantm

Quantm is an alignment optimization software application that examines alignment routing options with considerable variation in profile, length, cost, and environmental impacts to ascertain the most viable paths.

Since the Tehachapi Subsection is constrained by mountainous terrain, the Authority used Quantm, an alignment optimization software application, to determine a path through the Tehachapi Mountains that could maintain design criteria (including acceptable slopes) while factoring in construction costs. “Options” or local variations within an alternative, such as different profiles along the same alignment or routes that bypass critical natural resources or land uses, were also evaluated. Of the potential major paths of travel identified by Quantm, illustrated on Figure 2-40, those running parallel to the Program EIR/EIS Preferred Alignment along the SR 58 corridor were found to offer the best construction and operating environment in terms of access, constructability, and environmental issues. Of the multitude of alignment choices in the SR 58 corridor, the three that minimized tunnel length and the number of elevated structures (the greatest contributors to construction complexity and cost) were found to be the most cost-effective.

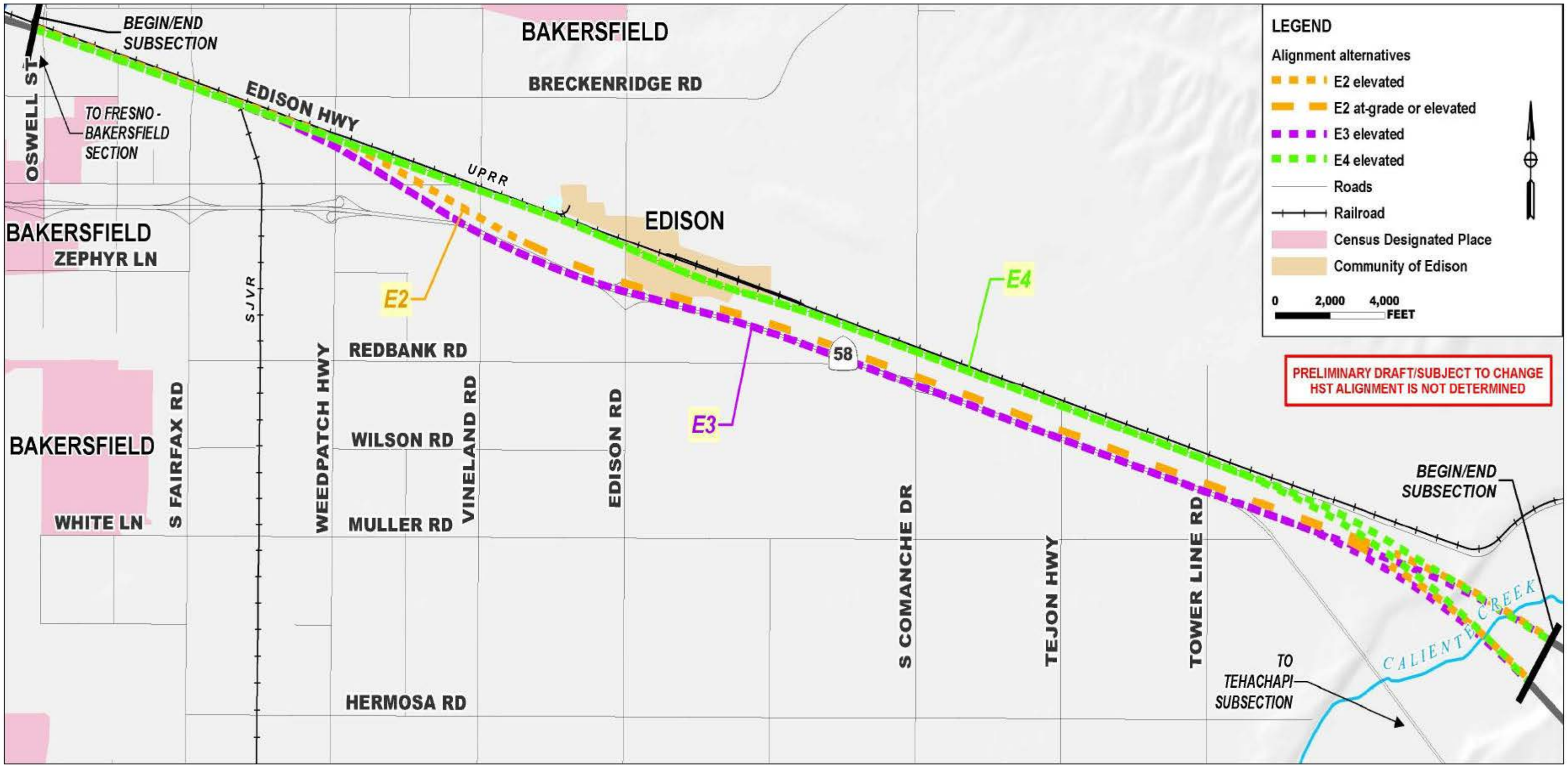
Following publication of the Statewide Program EIR/EIS in 2005, project engineering design criteria were published for project-level study of the selected corridors. In conjunction with the evaluation and refinement of initial alternatives, an engineering review was performed on the Statewide Program EIR/EIS Preferred Alignment to interpret its alignment and evaluate its consistency with the project engineering design criteria. This review concluded that the Statewide Program EIR/EIS Preferred Alignment, as interpreted, was not consistent with the design criteria as specified in the *Technical Memorandum – Alignment Design Standards for High-Speed Train Operation TM 2.1.2* (Authority 2009a). The inconsistencies were as follows:

- The maximum slope of the interpreted Program EIR/EIS Preferred Alignment was 4.8 percent, which exceeded the specified maximum of 3.5 percent.
- The maximum sustained slopes of the interpreted Program EIR/EIS Preferred Alignment of 3.5 percent for 8 miles and 3.2 percent for 8 miles exceeded the specified limits for slopes identified in the engineering criteria, which state that the average slope for any 3.7-mile-long section of the line will be under 3.5 percent and the average slope for any 6.2-mile-long section of the line will be under 2.5 percent.
- The minimum curve radius of 16,000 feet at four locations was less than the absolute radius allowed to permit 220 mph HSR operating speeds (the engineering guidelines allow 19,500 feet exceptional curve radius at 220 mph).



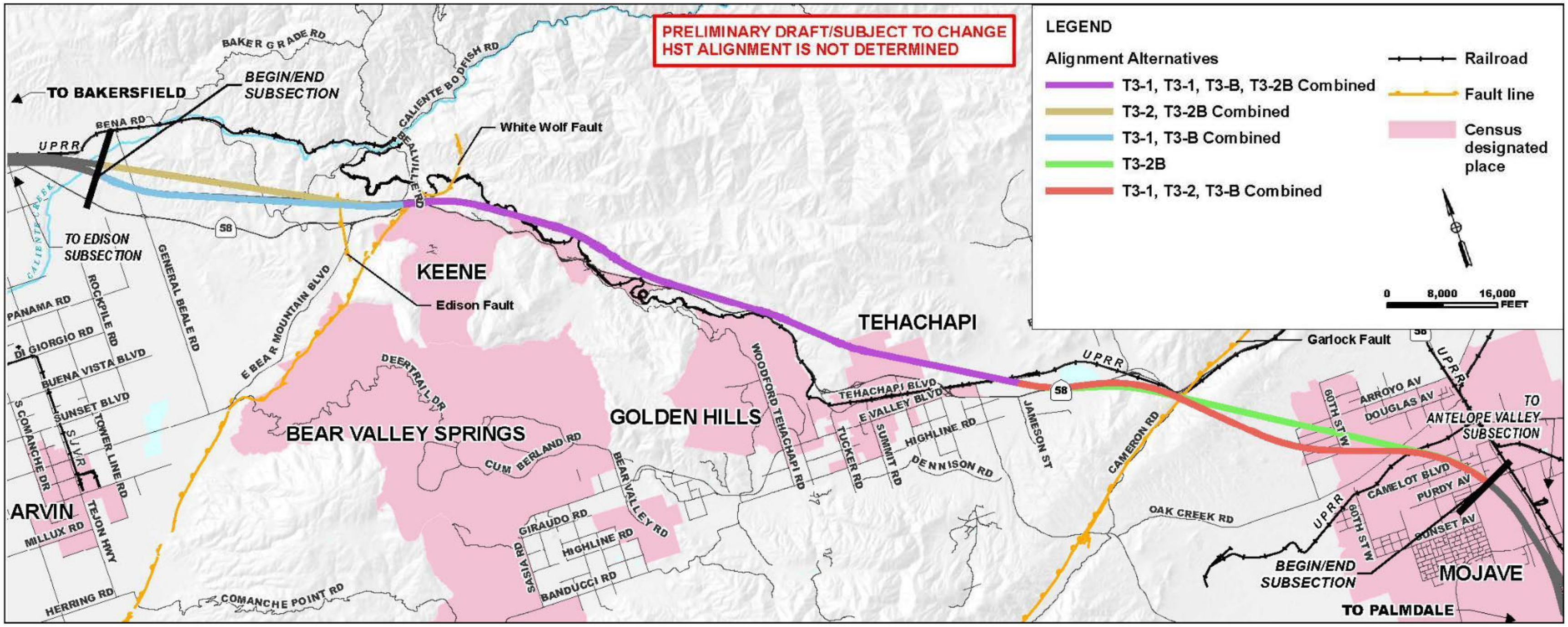
Source: California High-Speed Rail Authority, 2010b

Figure 2-35 Bakersfield to Palmdale Project Section—2010 PAA Alignment Subsections



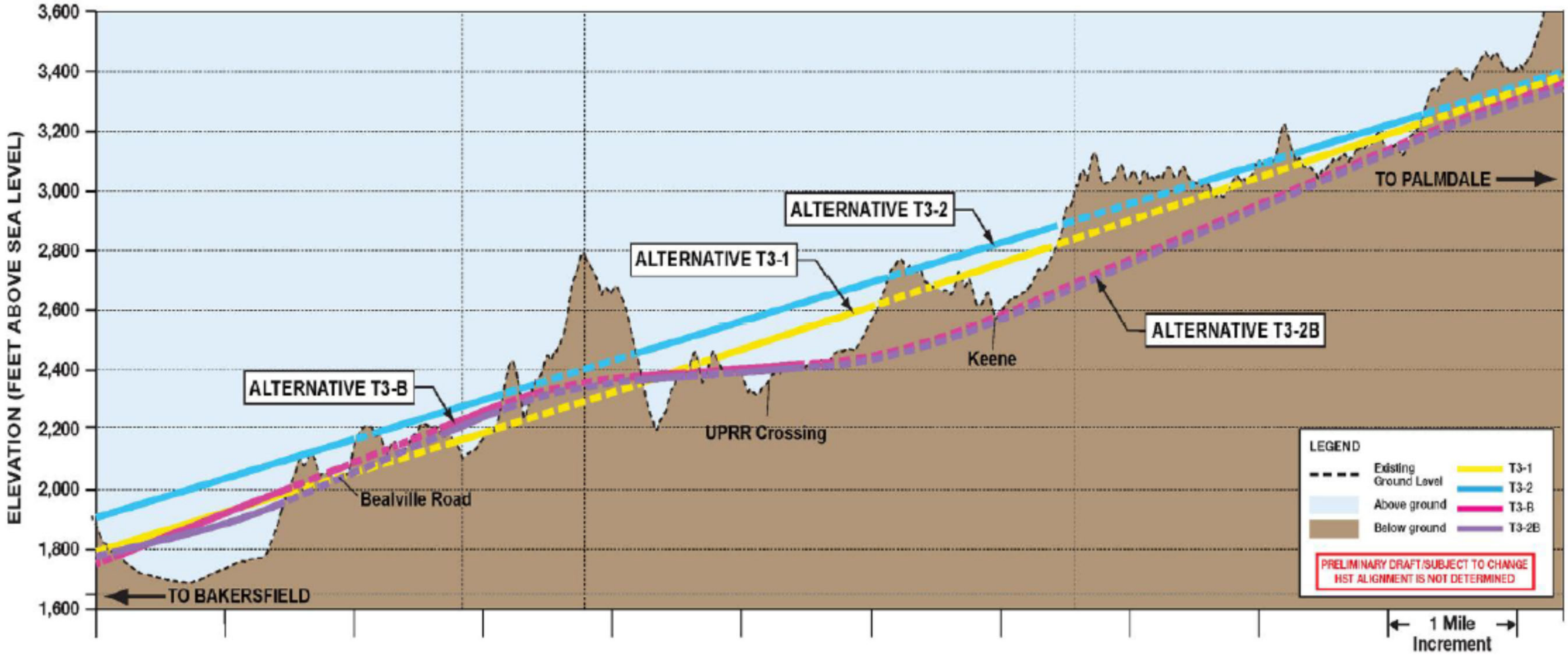
Source: California High-Speed Rail Authority, 2010b

Figure 2-36 Edison Subsection—2010 PAA Alignment Alternatives Considered



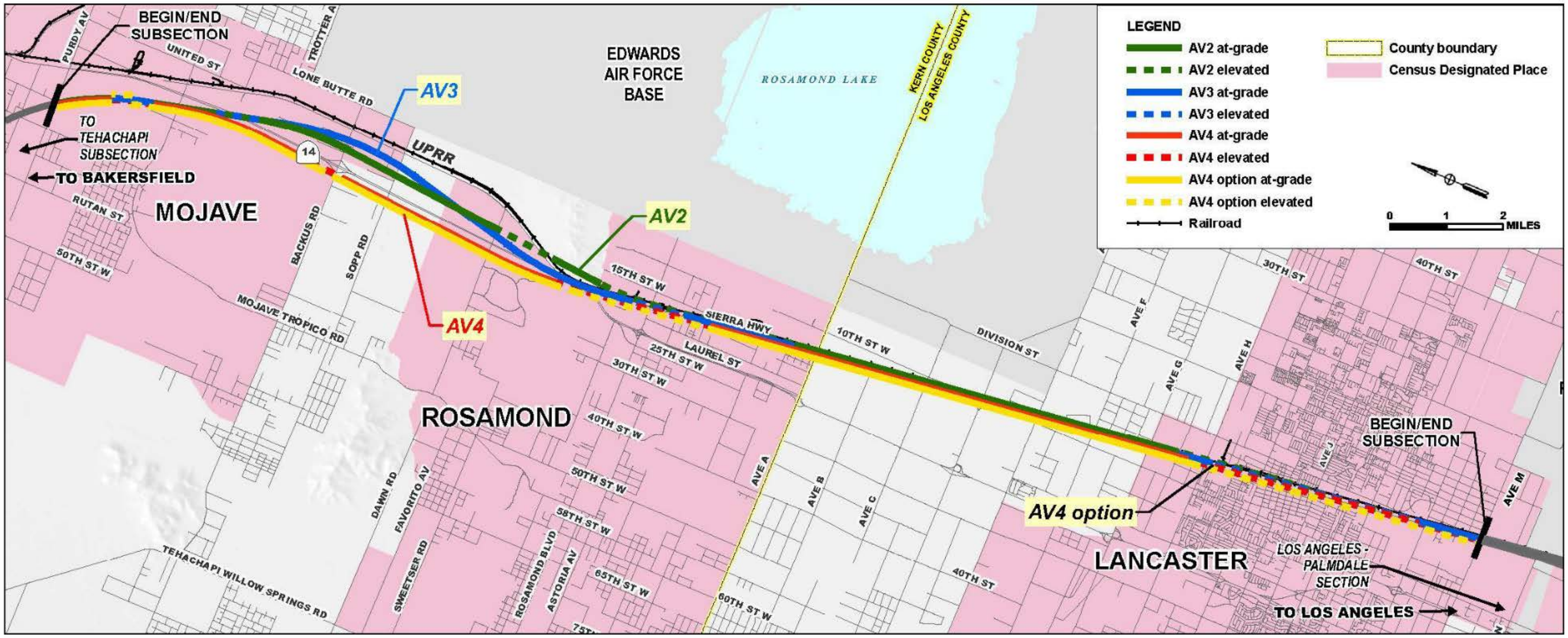
Source: California High-Speed Rail Authority, 2010b

Figure 2-37 Tehachapi Subsection—2010 PAA Alignment Alternatives Considered



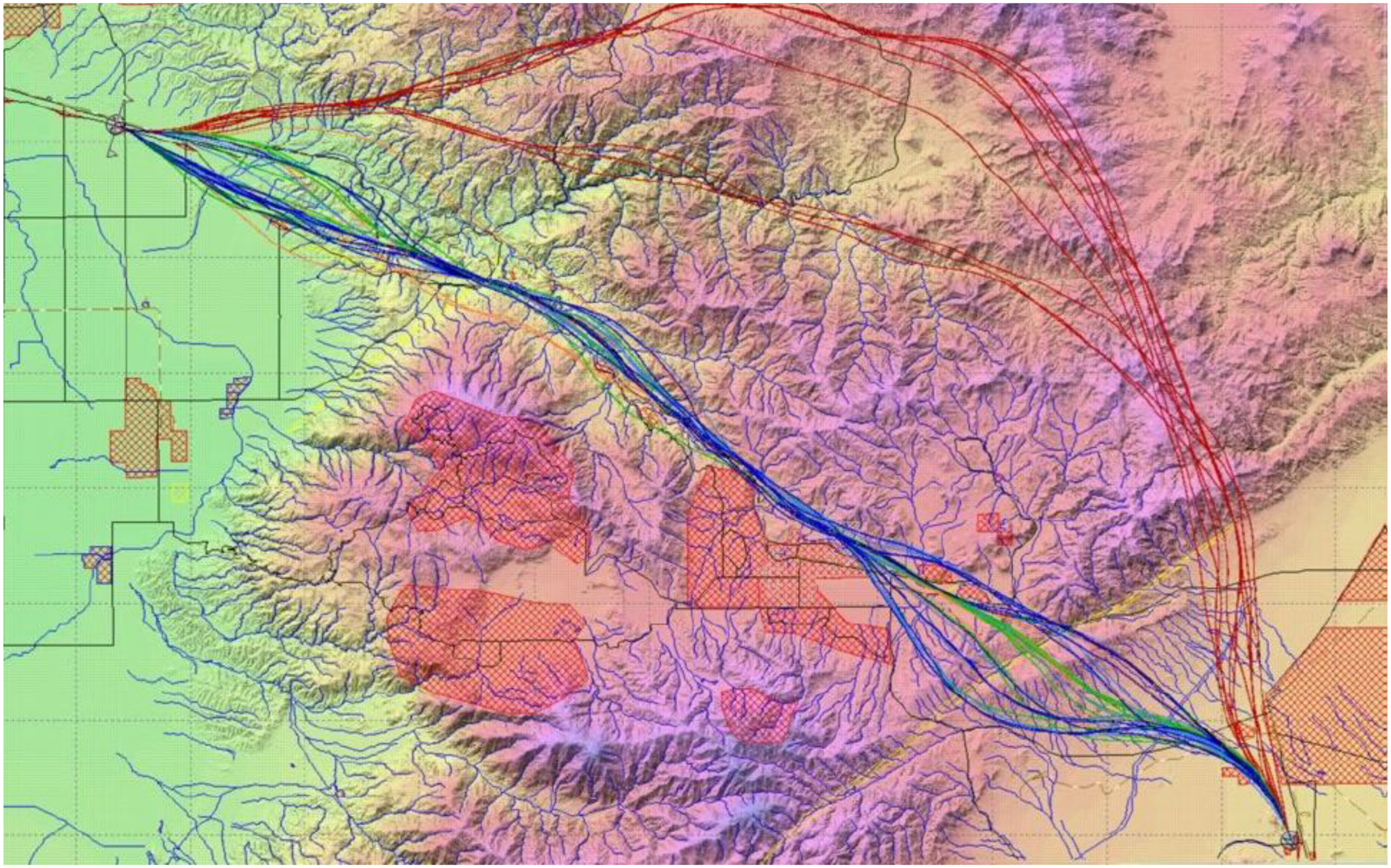
Source: California High-Speed Rail Authority, 2010b

Figure 2-38 Vertical Profiles of Tehachapi Subsection Alternatives—2010 PAA Alignment Alternatives Considered



Source: California High-Speed Rail Authority, 2010b

Figure 2-39 Antelope Valley Subsection—2010 PAA Alignment Alternatives Considered



Source: California High-Speed Rail Authority, 2010b

Figure 2-40 Quantm Alignment Options—2010 PAA

In addition, the Statewide Program EIR/EIS Preferred Alignment required two crossings of SR 58—one crossing Tehachapi Creek and the UPRR in a narrow canyon, and one crossing the Garlock Fault on a structure—both of which were either costly or infeasible according to the project design guidelines. As a result of the inconsistencies described above, the Statewide Program EIR/EIS Preferred Alignment was not carried forward for detailed evaluation. The alignment alternatives that were carried forward are, however, essentially variations on the Statewide Program EIR/EIS Preferred Alignment, with adjustments to conform to project engineering design criteria. Table 2-2 summarizes the findings and recommendations for the PAA alignment alternatives considered. Figure 2-41 (taken from the PAA) illustrates the alignment alternatives carried forward for further analysis.

The following alignment alternatives were recommended to be carried forward:

Edison Subsection

- Alternative E2A: SR 58 Adjacent North Side (Partially Elevated)
- Alternative E2B: SR 58 Adjacent North Side (All Elevated)
- Alternative E4: Along Edison Highway, Through Town of Edison (All Elevated)

Tehachapi Subsection

- Alternative T3-1: Quantm-Generated Alignment
- Alternative T3-2: Modified Quantm-Generated Alignment
- Alternative T3-B: Phase Break Alignment
- Alternative T3-2B: Revised Phase Break Alignment

Antelope Valley Subsection

- Alternative AV3B: Between UPRR and Sierra Highway (Partially Elevated)
- Alternative AV4 Option: Within or Adjacent to Sierra Highway—Completely Avoids UPRR Right-of-Way (Primarily Elevated)

2.3.12.4 Supplemental Alternatives Analysis Reports

2012 Supplemental Alternatives Analysis

The 2012 SAA (Authority 2012a, 2012b) presented a refined range of alternatives for the SR 58/ Soledad Canyon Corridor (Antelope Valley) alignment based on new information obtained since the previous study. The 2012 SAA responded specifically to the Authority's concerns about reducing environmental impacts and overall project costs. Potential land use conflicts, wetland issues, and other potential environmental impacts, project purpose/objectives and requirements, and stakeholder input were considered in modifying the alternatives. In addition, the higher costs associated with elevated profiles and tunneling were reduced by increasing track grade; lowering alignment profiles and bringing them close to grade; and reducing tunnel length where possible. Figure 2-42 (taken from the 2012 SAA) illustrates the alignment alternatives.

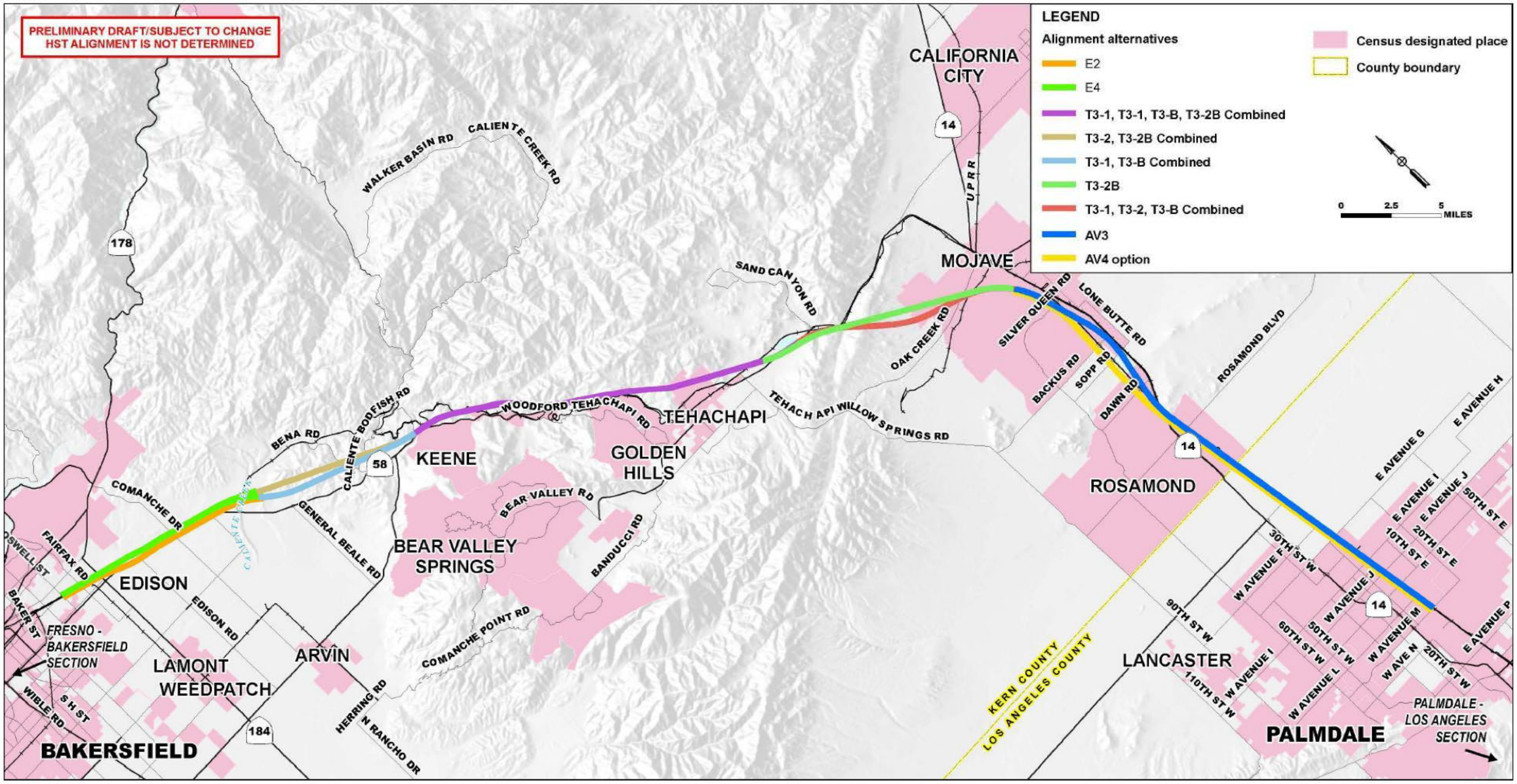
The proposed alignments in the 2012 SAA had been moved since the PAA was published to avoid permanent direct effects on La Paz, and the associated access road had been moved to avoid the property as well.

Table 2-2 2010 Preliminary Alignment Alternatives Considered

Alignment Alternative	Decision		Reasons for Elimination (P = Primary; S = Secondary)							Environmental/Other Concerns
	Carried Forward	Withdrawn	Construction	Incompatibility	Right-of-Way	Connectivity/ Accessibility	Revenue/Ridership	Community Impact	Environment	
Edison Subsection										
E2A: SR 58 Adjacent North Side (Partially At Grade)	X									Traffic effects; costs; agricultural displacements
E2B: SR 58 Adjacent North Side (All Elevated)	X									Constructability; agricultural displacements; traffic effects
E3: In SR 58 Median (All Elevated)		X	P		S			S		Traffic effects; lengthy approval process from Caltrans; agricultural displacements; cost; length of elevated alignment
E4: Along Edison Highway (All Elevated)	X									Residential displacements; traffic effects
Tehachapi Subsection										
T3-1: Quantm-Generated Alignment, 2.65% Average Slope, 2.75% Sustained Slope over 12 miles	X									Does not allow "phase break for" traction power facilities
T3-2: Modified Quantm-Generated Alignment, 2.5% Average Slope, 2.5% Sustained Slope over 20 miles	X									Agricultural displacements; length of elevated structure; costs; biological resources
T3-B: Phase Break Alignment, 2.65% Average Slope, 3.5% Sustained Slope over 3.4 miles	X									Constructability; length and height of elevated structure; costs
T3-2B: Revised Phase Break Alignment, 2.5% Average Slope, 3.5% Sustained Slope over 3.4 miles	X									Length of tunneling; capital cost; biological resources

Alignment Alternative	Decision		Reasons for Elimination (P = Primary; S = Secondary)							Environmental/Other Concerns
	Carried Forward	Withdrawn	Construction	Incompatibility	Right-of-Way	Connectivity/ Accessibility	Revenue/Ridership	Community Impact	Environment	
Antelope Valley Subsection										
AV2: East Side of UPRR (Mixed At Grade and Elevated)		X	P		P			S		Traffic effects; costs; encroachment on UPRR parcels; constructability
AV3A: Between UPRR and Sierra Highway (All At Grade)		X	P	P	P			S		Displacements; traffic effects; conflicts with the City of Lancaster's redesign of Lancaster Boulevard; encroachment on UPRR property
AV3B: Between UPRR and Sierra Highway (Partially Elevated)	X									Displacements; traffic effects; encroachment on UPRR property
AV4: Within or Adjacent to Sierra Highway (Primarily Elevated)		X			P			P		Displacements; noise and vibration; traffic effects; encroachment on UPRR property
AV4 Option: Within or Adjacent to Sierra Highway—UPRR Avoidance Option (Primarily Elevated)	X									Traffic effects; noise and vibration

Source: California High-Speed Rail Authority, 2010b
Caltrans = California Department of Transportation
SR = State Route
UPRR= Union Pacific Railroad



Source: California High-Speed Rail Authority, 2010b
Alignment Alternative E2 is representative of E2A and E2B.

Figure 2-41 2010 PAA Alignment Alternatives Carried Forward

The 2012 SAA identified two potential station locations in Palmdale that were under consideration in the adjacent Palmdale to Los Angeles project section, which the Antelope Valley subsection alternatives would tie in to. The eastern station location was along the UPRR tracks at the existing Palmdale Transportation Center (Metrolink) Station (SR 14 East). The western station location, called Palmdale West Station (SR 14 West), was in an undeveloped area north of Avenue P in Palmdale. These two station options in Palmdale were discussed in the Palmdale to Los Angeles Preliminary Alternatives Analysis (July 2010), and further identified in the Palmdale to Los Angeles Supplemental Alternatives Analysis (April 2012). The tie-ins within the Bakersfield to Palmdale 2012 SAA ensured that a connection between either of the two Antelope Valley Subsection alternatives and either Palmdale Station location would be possible, in accordance with the Authority's engineering design standards.

The following recommendations were made in the 2012 SAA, based on the evaluations presented for the Edison, Tehachapi, and Antelope Valley Subsections of the Bakersfield to Palmdale Project Section. The 2012 SAA recommendations are illustrated on Figure 2-42.

Edison Subsection

- Carry forward Preliminary AA E2B (all elevated) and New E2 (close to grade), working with Caltrans, Kern County, and other key stakeholders to develop the optimal profile for E2.
- Withdraw Preliminary AA E2A from further consideration. (E2A is the same horizontal alignment as E2B, but only partially elevated.) E2A would displace similar acreages of agricultural land and other uses and cause more extensive reconstruction of multiple SR 58 interchanges than New E2.
- Carry forward Preliminary AA E4 (all elevated) and New E4 (primarily at grade) to determine the optimal profile and to minimize impacts to the community of Edison and to agricultural businesses along Edison Highway.

Tehachapi Subsection

- Carry forward Preliminary AA T3-1 to assess potential environmental impacts and benefits associated with viaducts and tunnels in this alternative.
- Carry forward New T3, which has a shorter route and steeper gradients. This limits the length of tunnels and viaducts relative to the Preliminary AA alternatives.
- Carry forward and refine Preliminary AA T3-2 using the same gradient variances as applied to the design of New T3.
- Withdraw Preliminary AA T3-B and Preliminary AA T3-2B (phase-break alternatives) from further consideration.

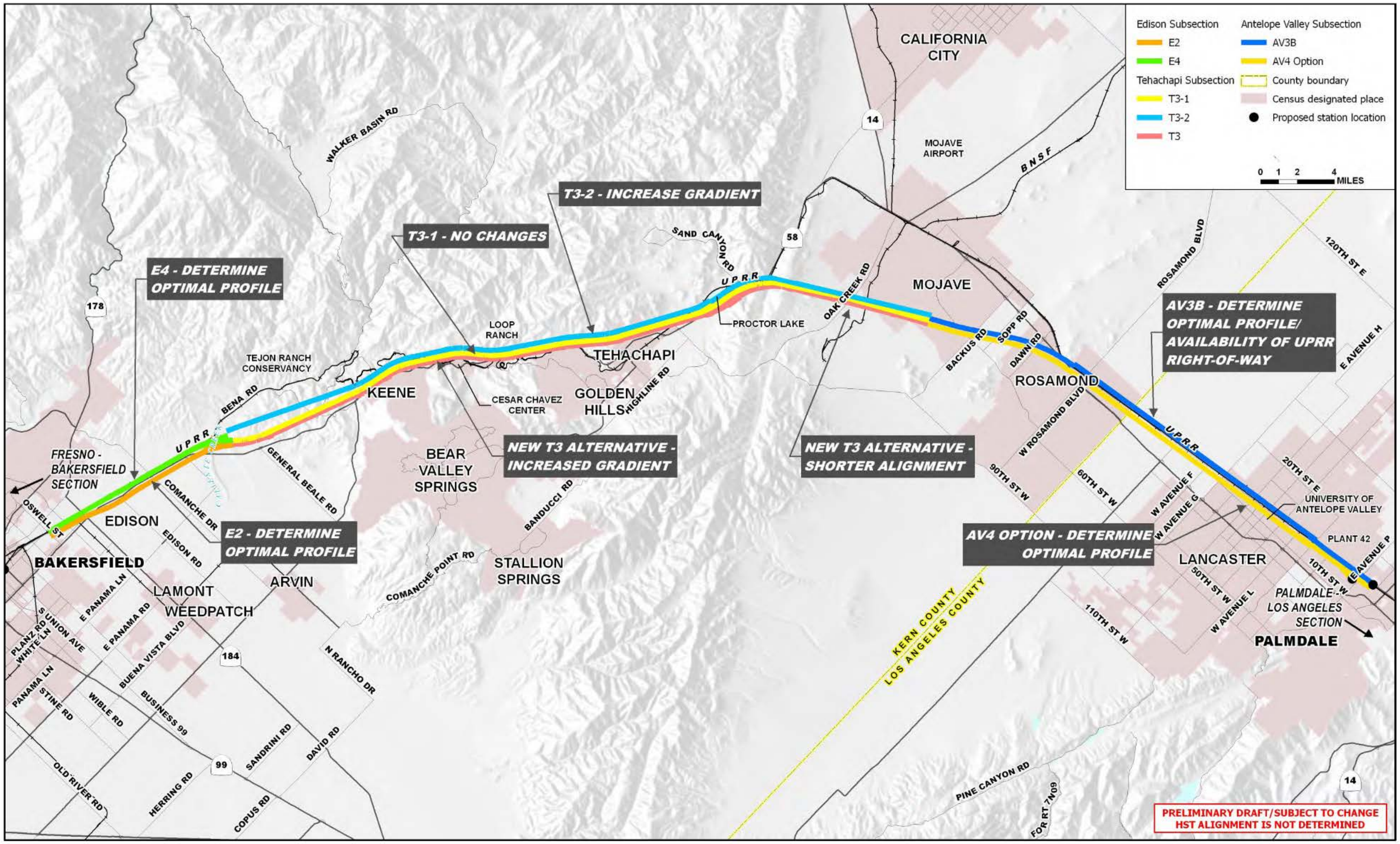
Antelope Valley Subsection

- Carry forward Preliminary AA AV3B and New AV3B; carry forward Preliminary AA AV4 Option and New AV4 Option. Work with key stakeholders, including UPRR, to determine the optimal profile for the AV3B and New AV4 Option Alternatives.

2014 and 2015 Continued Outreach and Refinement of Alternatives

Following the 2012 SAA, the Authority continued to refine the alternatives by responding to stakeholder, agency, and public comments; performing additional engineering and environmental review; and maintaining consistency with the Authority's design objectives. Work performed between the conclusion of the 2012 SAA and January 2014 resulted in an unpublished Interim Draft SAA report dated January 2014.[7] Work performed since January 2014 resulted in continued refinements and adjustments to previous alignments due to new stakeholder, agency, environmental, and engineering input.

[7] The 2014 Interim Draft SAA was not presented to the board or the public, but it was made available as a result of a Public Records Act request.



Source: California High-Speed Rail Authority, 2012a

Figure 2-42 2012 SAA Alignment Alternatives Carried Forward

The 2010 PAA, 2012 SAA, and interim unpublished Draft 2014 SAA reports, as well as additional input since those reports, all identified and recommended an HSR route between Bakersfield and Palmdale that generally followed existing transportation corridors, including Edison Highway, SR 58, and Sierra Highway. While the route between Bakersfield and Palmdale had been established, numerous alignment options evolved along key subsections of the route to address local concerns and issues in each subsection. Since none of the Bakersfield to Palmdale subsections overlap, all options for all subsections are compatible with each other.

The Palmdale West Station (SR 14 West) was eliminated as a station alternative, as documented in the Palmdale to Los Angeles Supplemental Alternatives Analysis report (May 2014), because it did not satisfy the project purpose and objective of providing connectivity with other transportation modes.[8] Principally, the Palmdale West Station (SR 14 West) would not connect with Metrolink commuter rail service in Palmdale or other transportation modes. The Palmdale Transportation Center (SR 14 East) in contrast, provides a Metrolink commuter rail service connection to Los Angeles and serves as a hub for the Antelope Valley Transit Authority, Palmdale's local bus system, as well as a hub for its commuter bus network to Los Angeles (Metrolink 2017; Antelope Valley Transit Authority 2015). The City of Palmdale is focusing local planning efforts for transit oriented development and multi model integration at and near the Palmdale Transportation Center (SR 14 East) and has no similar plans for the Palmdale West Station location. In addition the Palmdale Transportation Center Station is being studied as a possible feeder link between the planned DesertXpress HSR line[9] to Las Vegas and the California HSR System (Caltrans 2014b). The Authority therefore focused its further planning efforts on the Palmdale Transportation Center.

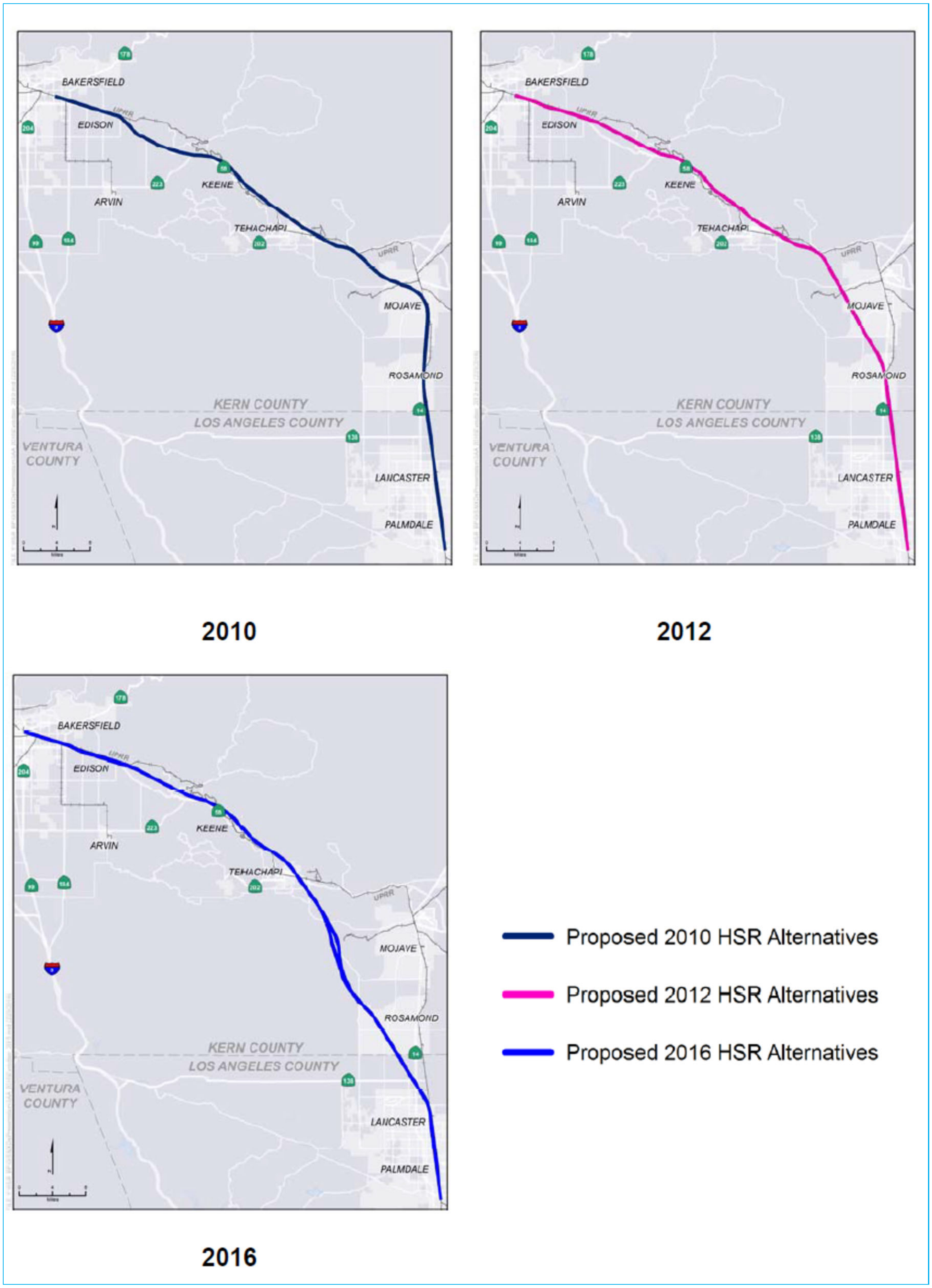
2016 Supplemental Alternatives Analysis

The 2016 SAA provides updates to the 2012 SAA and 2010 PAA. The alternatives studied in the 2016 SAA are an evolution of the alternatives studied in the 2012 SAA, as illustrated on Figure 2-43, followed by additional conceptual engineering and draft studies undertaken since January 2014, as discussed in the 2016 ASM (included as an appendix in the 2016 SAA). While the previous SAA evaluated three subsections, the 2016 SAA added a new subsection for the Keene area to allow for more focus on that community.

The 2016 ASM presented the rationale for screening and removing several subsection alignment options proposed by previous and current studies (including the continued 2015 studies). The 2016 ASM also resulted in the consolidation of the remaining subsection alignment options into complete end-to-end alignment alternatives. Table 2-3 summarizes how different variations of the selected subsection alignment options combine to create the complete end-to-end alignment alternatives. Figure 2-44, Figure 2-45, Figure 2-46, and Figure 2-47 (taken from the 2016 ASM) illustrate the subsection alignment options.

[8] Each project section of the HSR system includes connectivity to other transportation modes in the project purpose and project objectives.

[9] The name of this project has changed to XpressWest.

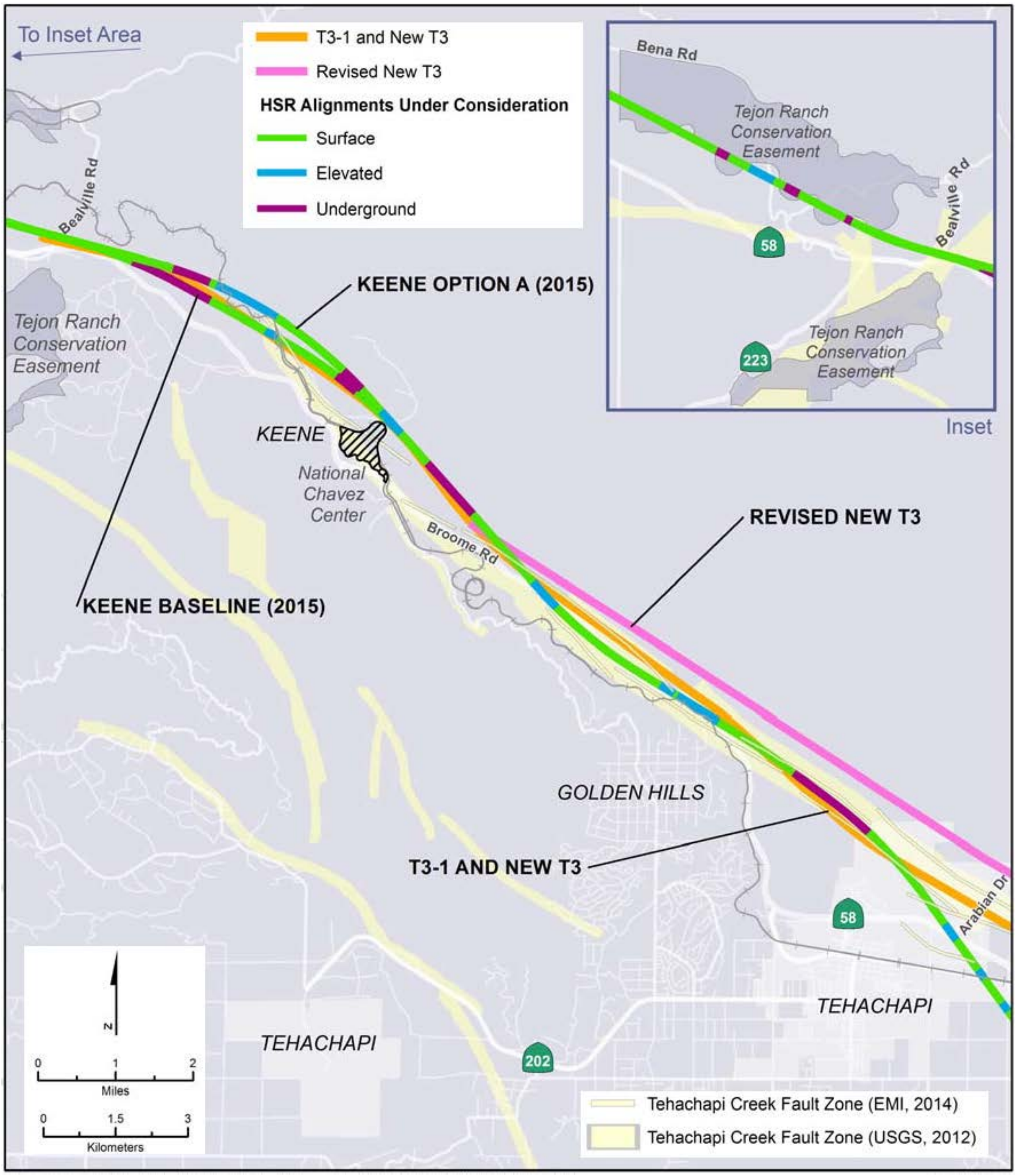


Source: California High-Speed Rail Authority, 2016a

Figure 2-43 Evolution of Alternatives

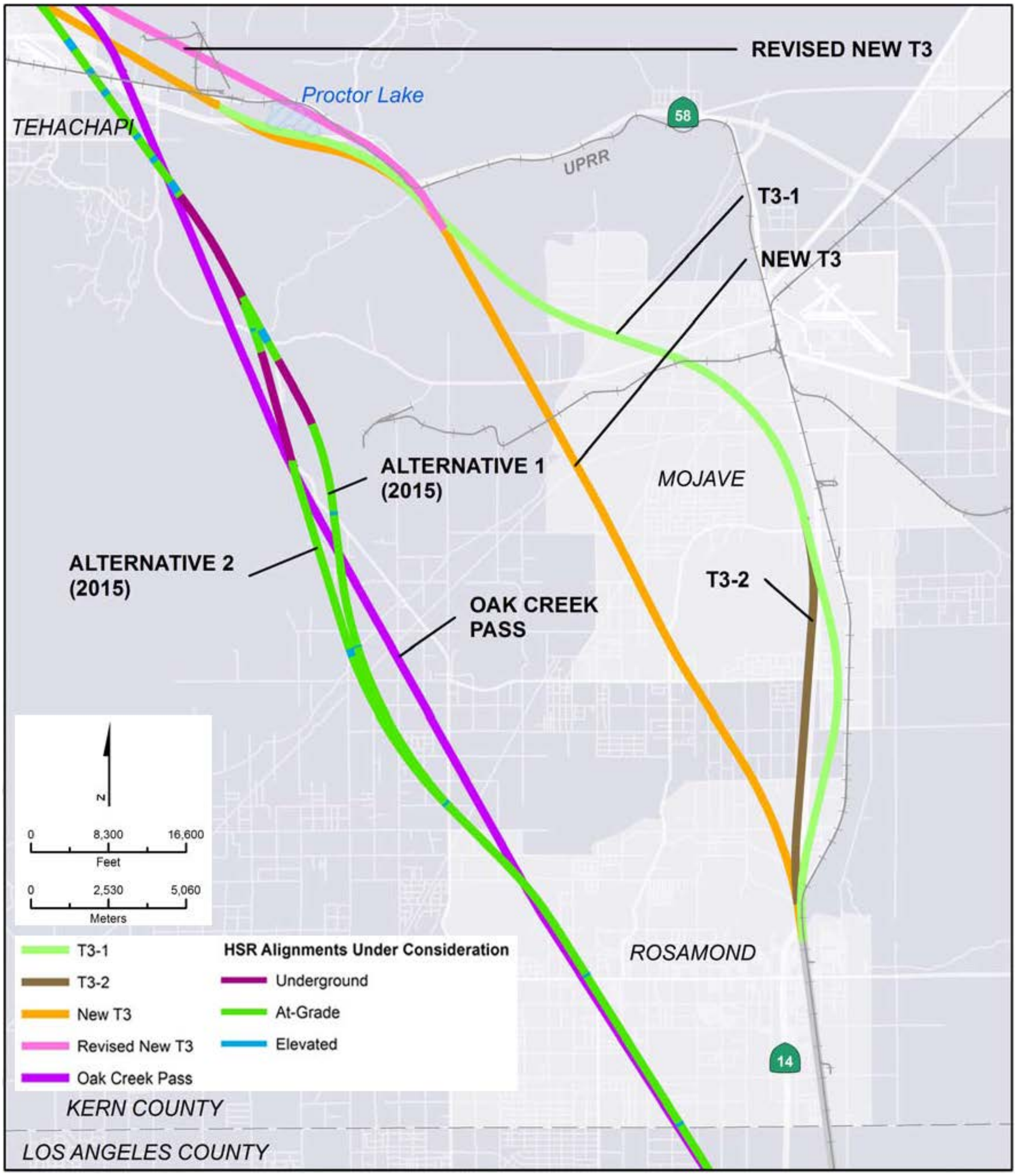
Source: California High-Speed Rail Authority, 2016a

Figure 2-44 Edison Subsection—2016 SAA Alignment Options



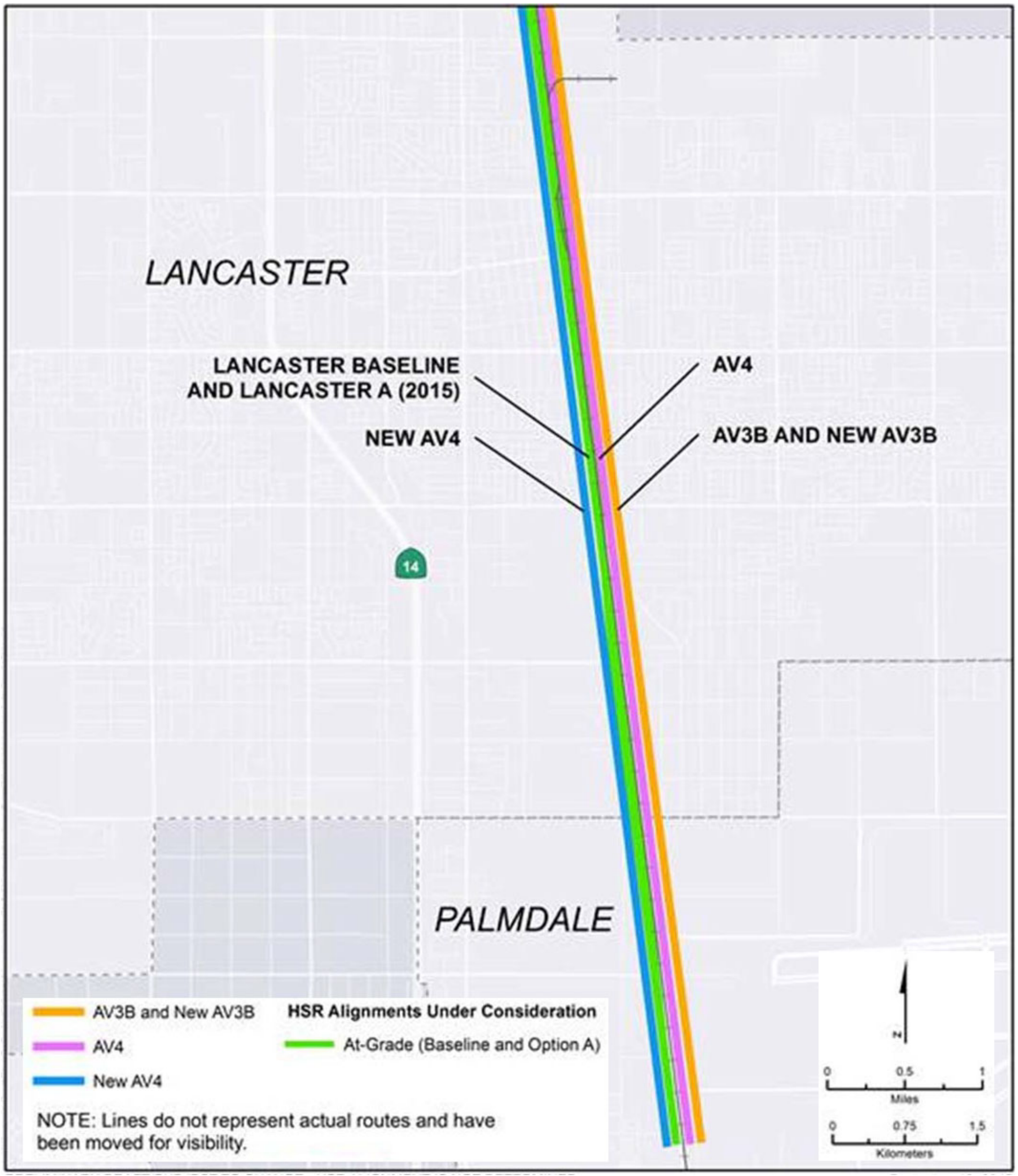
Source: California High-Speed Rail Authority, 2016a

Figure 2-45 Keene Subsection—2016 SAA Alignment Options



Source: California High-Speed Rail Authority, 2016a

Figure 2-46 Tehachapi Subsection—2016 SAA Alignment Options



Source: California High-Speed Rail Authority, 2016a

Figure 2-47 Lancaster Subsection—2016 SAA Alignment Options

Table 2-3 2016 Supplemental Alternatives Analysis Alternatives

Alignment Alternative	Edison Subsection		Keene Subsection	Tehachapi Subsection		Lancaster Subsection	
	Baseline	Option A	Baseline	Alternative1	Alternative 2	Baseline	Option A
Alternative 1	X		X	X		X	
Alternative 2		X	X	X		X	
Alternative 3	X		X		X	X	
Alternative 4		X	X		X	X	
Alternative 5	X		X	X			X
Alternative 6		X	X	X			X
Alternative 7	X		X		X		X
Alternative 8		X	X		X		X

Source: California High-Speed Rail Authority, 2016a

The alternatives evaluated and recommended in the 2016 SAA incorporate refinements that, when compared to the alternatives studied in the 2012 SAA and the 2010 PAA, further avoid or minimize potential impacts on existing facilities, land uses, and environmental resources. In addition, these refinements improve the constructability of the Bakersfield to Palmdale Project Section and optimize system operations. The recommended alternatives reflect engineering refinement, collaborative engagement with communities along the Bakersfield to Palmdale Section, and environmental studies conducted since the 2012 SAA. The 2016 SAA evaluated the eight end-to-end alignment alternatives from the 2016 ASM. Figure 2-48 (taken from the 2016 SAA) illustrates the eight end-to-end alignment alternatives. The 2016 SAA presented the rationale for screening and removing several end-to-end alignment alternatives, resulting in four end-to-end alternatives.[10]

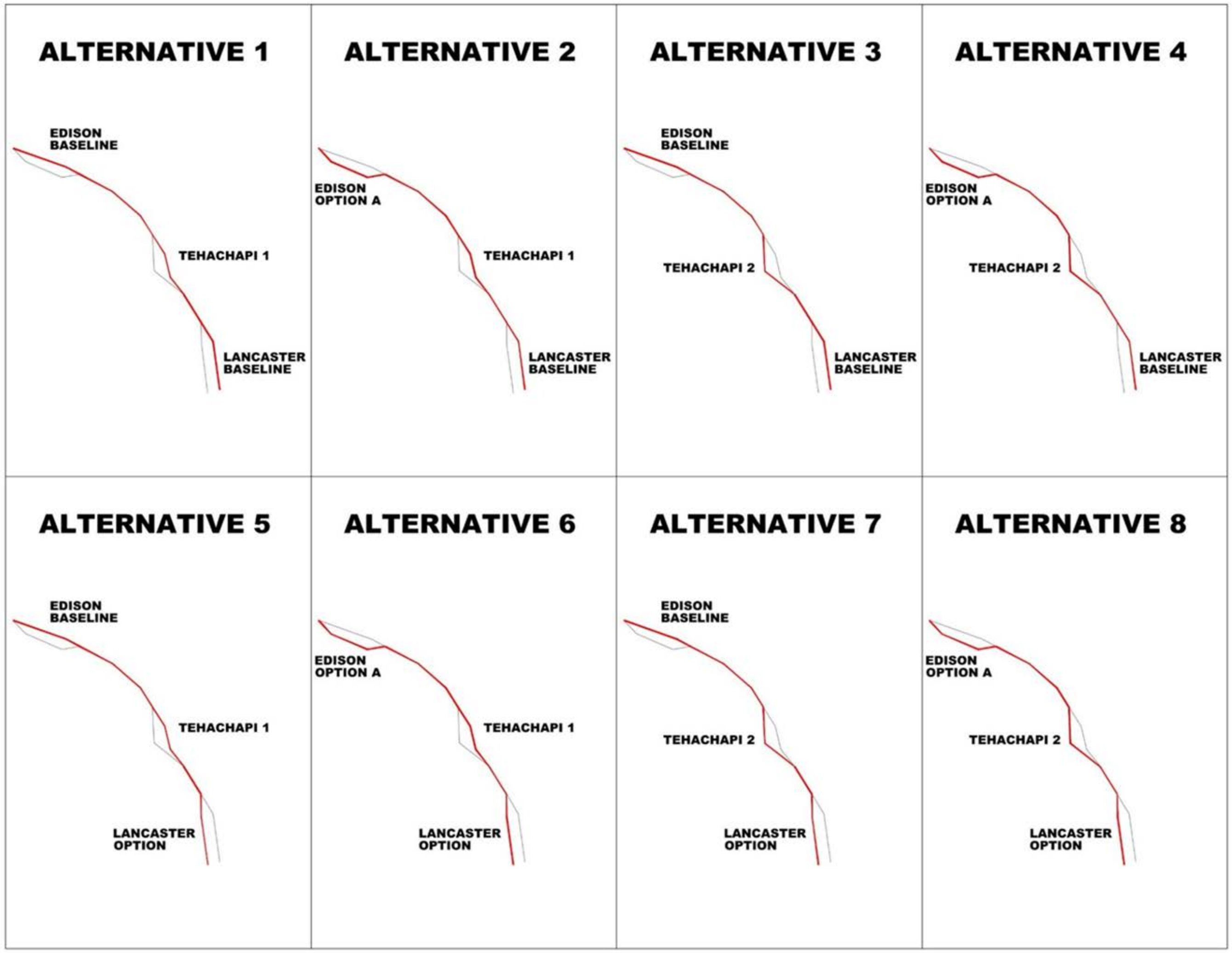
Specifically, the 2016 SAA concluded that Alternatives 1, 2, 3, and 5 would be generally more constructible (fewer tunnel miles and lower capital costs) and would generally have lower potential impacts on right-of-way and displacements, potential Section 4(f) resources, cultural resources, and community resources compared to Alternatives 4, 6, 7, and 8. Therefore, Alternatives 4, 6, 7, and 8 were recommended for withdrawal. A list of all recommended alternatives previously identified through the SAA process is provided in Table 2-4.

Community Engagement

The Authority has held meetings to gather, confirm, and understand key community concerns in order for these concerns to be incorporated both into the development of Build Alternatives and during the environmental process for the Bakersfield to Palmdale Project Section. The Authority used the feedback from these meetings to develop the Build Alternatives and design refinements shared with the public during several rounds of outreach efforts. The meetings included the following:

- Four stakeholder working groups held in September 2015
- Five open house meetings held in September and October 2015
- More than 150 briefings with community stakeholders, businesses, local agencies, and elected officials

[10] The 2016 SAA is available upon request from the Authority at: records@hsr.ca.gov.



Source: California High-Speed Rail Authority, 2016a

Figure 2-48 2016 SAA Alignment Alternatives Considered (Alternatives 1, 2, 3, and 5, Carried Forward to Project EIR/EIS)

Table 2-4 Previous and Current Alternatives

Alignment Alternative	Carried Forward	Withdrawn	Key Reasons for Withdrawal
SAAs (2012, 2014 Draft)			
E2B Alternative	Carried forward in 2012 SAA	Withdrawn in 2015 studies	▪ There are high costs with all viaducts, contrary to HSR objectives to provide an economically viable project. ▪ Some portions of the alignment remain parallel to the Tehachapi Creek Fault Zone, contrary to design guidelines. ▪ The alignment is in close proximity to schools and environmental justice communities.
New E2 Alternative (at-grade modification of E2B profile)	Carried forward in 2012 SAA	Withdrawn in 2015 studies	▪ Some portions of the alignment remain parallel to the Tehachapi Creek Fault Zone, contrary to design guidelines. ▪ The alignment is in close proximity to schools and environmental justice communities.
E4 Alternative	Carried forward in 2012 SAA	Withdrawn in 2014 Draft SAA	▪ There are high costs with all viaducts, contrary to HSR objectives to provide an economically viable project. ▪ All structures are in a fault zone, contrary to design guidelines.
New E4 Alternative (at-grade modification of E4 profile)	Carried forward in 2012 SAA	Withdrawn in 2014 Draft SAA	▪ Some structures are in a fault zone, contrary to design guidelines. ▪ Local businesses and schools have raised strong objections.
Edison Baseline	Carried forward in 2015 studies	Not withdrawn	–
Edison A	Carried forward in 2015 studies	Not withdrawn	–
Edison B	Carried forward in 2015 studies	Withdrawn in 2015 studies	▪ There are significant impacts on businesses along Edison Highway.
T3-1 Alternative	Carried forward in 2012 SAA	Withdrawn in 2014 Draft SAA	▪ Some structures are in the Tehachapi Creek Fault Zone, contrary to design guidelines. ▪ The alignment bisects a portion of the Tejon Ranch Conservancy property.
New T3 Alternative (reduce elevated profile of T3-1)	Carried forward in 2012 SAA	Withdrawn in 2014 Draft SAA	▪ Some structures are in the Tehachapi Creek Fault Zone, contrary to design guidelines. ▪ The alignment bisects a portion of the Tejon Ranch Conservancy property. ▪ The vertical profile grades exceed the recommended 2.8%.
T3-2 Alternative	Carried forward in 2012 SAA	Withdrawn in 2014 Draft SAA	▪ Some structures are in the Tehachapi Creek Fault Zone, contrary to design guidelines.
Revised New T3 Alternative[1]	Carried forward in 2014 Draft SAA	Withdrawn in 2015 studies	▪ The fault zone that the alignment was based on has since been revised significantly, affecting the potential locations for alignments. ▪ The alternative increases tunnel lengths and costs based on the horizontal location of the alignment. ▪ The vertical profile grades exceed the recommended 2.8%.

Alignment Alternative	Carried Forward	Withdrawn	Key Reasons for Withdrawal
Keene Baseline	Carried forward in 2015 studies	Not withdrawn	–
Keene A	Carried forward in 2015 studies	Withdrawn in 2015 studies	▪ Creates costly viaducts exceeding 250 feet high. ▪ Tunnel to viaduct length exceeds Authority guidelines. ▪ Tunnel portal and bridge abutments over UPRR may be infeasible to build. ▪ Difficult or infeasible to provide access road to tunnel portal. ▪ Alignment location is less desirable to Cummings Ranch owner.
Oak Creek Pass Alternative[1]	Carried forward in 2014 Draft SAA	Withdrawn in 2016 ASM	▪ The fault zone that the alignment was based on has since been revised significantly, affecting the potential locations for alignments. ▪ The alternative increases tunnel lengths and costs based on the horizontal location of the alignment due to fault avoidance. ▪ The vertical profile grades exceed the optimal 2.8%. ▪ Wind turbine impacts are still high compared to Alternatives 1 and 2 (26 impacts versus 10).
Alternative 1	Carried forward in 2015 studies	Not withdrawn	–
Alternative 2	Carried forward in 2015 studies	Not withdrawn	–
AV3B Alternative	Carried forward in 2012 SAA	Withdrawn in 2015 studies	▪ The alignment is completely on elevated structures, contrary to the City of Lancaster's desires. ▪ Costs are high due to extensive elevated structures.
New AV3B Alternative (primarily at-grade modification of AV3B profile)	Carried forward in 2012 SAA	Withdrawn in 2015 studies	▪ The alignment does not comply with the UPRR memorandum of understanding separation requirements.
AV4 Alternative	Carried forward in 2012 SAA	Withdrawn in 2015 studies	▪ The alignment is completely on elevated structures, contrary to city desires. ▪ Costs are high due to extensive elevated structures.
New AV4 Alternative (primarily at-grade modification of AV4 profile)	Carried forward in 2012 SAA	Withdrawn in 2014 Draft SAA	▪ The alternative significantly affects numerous businesses on the west side of Sierra Highway. ▪ Portions of the alignment sandwich Sierra Highway between the HSR tracks and the existing UPRR/Metrolink corridors, eliminating access to Sierra Highway. ▪ The city does not want this alignment.
Lancaster Baseline	Carried forward in 2015 studies	Not withdrawn	–
Lancaster A	Carried forward in 2015 studies	Not withdrawn	–

Alignment Alternative	Carried Forward	Withdrawn	Key Reasons for Withdrawal
2016 SAA			
Alternative 1	Carried forward in 2016 ASM, 2016 SAA	Not withdrawn	▪ Alternatives 1, 2, 3, and 5 are generally more constructible (fewer tunnel miles and lower capital costs) and generally have lower potential impacts on right-of-way and displacements, potential Section 4(f) resources, cultural resources, and community resources compared to Alternatives 4, 6, 7, and 8.
Alternative 2	Carried forward in 2016 ASM, 2016 SAA	Not withdrawn	▪ Same reasons as described under Alternative 1.
Alternative 3	Carried forward in 2016 ASM, 2016 SAA	Not withdrawn	▪ Same reasons as described under Alternative 1.
Alternative 4	Carried forward in 2016 ASM	Withdrawn in 2016 SAA	▪ The alternative does not minimize potential uses of existing and potential Section 4(f) resources (it requires relocation of the Pacific Crest Trail). ▪ The alternative does not minimize potential impacts on wetlands/aquatic resources.
Alternative 5	Carried forward in 2016 ASM, 2016 SAA	Not withdrawn	▪ Same reasons as described under Alternative 1.
Alternative 6	Carried forward in 2016 ASM	Withdrawn in 2016 SAA	▪ The alternative does not minimize potential impacts on potential cultural resources. ▪ The alternative does not minimize disruption to local communities because it would result in a higher number of residential, commercial, and industrial parcels potentially disrupted.
Alternative 7	Carried forward in 2016 ASM	Withdrawn in 2016 SAA	▪ The alternative does not minimize potential uses of existing and potential Section 4(f) resources. ▪ The alternative does not minimize potential impacts on potential cultural resources. ▪ The alternative does not minimize potential impacts on wetlands/aquatic resources.
Alternative 8	Carried forward in 2016 ASM	Withdrawn in 2016 SAA	▪ The alternative does not minimize potential uses of existing and potential Section 4(f) resources. ▪ The alternative does not minimize potential impacts on potential cultural resources. ▪ The alternative does not minimize potential impacts on wetlands/aquatic resources.

[1] Alignment from the 2014 Draft SAA, which was never published; alignment results are discussed in the 2016 ASM.
ASM = Alternatives Screening Memorandum
SAA = Supplemental Alternatives Analysis
Authority = California High-Speed Rail Authority
UPRR = Union Pacific Railroad
HSR = high-speed rail

2.3.12.5 Further Outreach, Consultation, and Alternatives Refinement Since the 2016 SAA

Since January 2015, the Authority has also held monthly regulatory agency meetings to discuss the Southern California project sections, including the Bakersfield to Palmdale Project Section. These meetings provided an opportunity to review comments on draft documents and discuss the upcoming project schedule. Chapter 9, Public and Agency Involvement, describes all of the public and agency involvement and outreach efforts conducted in the preparation of this Bakersfield to Palmdale Project Section Draft EIR/EIS.

In 2016, 2017, and 2018, the Authority and the FRA engaged in further consultation regarding two Section 4(f) resources located within the Bakersfield to Palmdale Project Section: La Paz and the Pacific Crest Trail. The Authority coordinated with the California Office of Historic Preservation as well as representatives of the National Chávez Center. Meetings were also held with the FRA, the National Park Service, the National Chávez Center, the Advisory Council on Historic Preservation, and the National Parks Conservation Association regarding potential impacts on La Paz. This consultation effort resulted in the development of the César E. Chávez National Monument Design Option (CCNM Design Option). The Authority and FRA also met with the U.S. Bureau of Land Management (BLM), the U.S. Forest Service, and the Pacific Crest Trail Association on several occasions to discuss the Pacific Crest Trail crossing for the purposes of NEPA and Section 4(f).

Chapter 4, Final Section 4(f)/6(f) Evaluations, also provides information on coordination with regard to La Paz and the Pacific Crest Trail. In addition, Section 3.17, Cultural Resources, provides information on coordination regarding La Paz, which is considered a cultural resource.

2.4 Alignment, Station Sites, Light Maintenance Facility, and Maintenance of Infrastructure Alternatives Evaluated in This Project EIR/EIS

This section describes the alternatives evaluated in this EIR/EIS, beginning with the No Project Alternative and then carrying on to Alternatives 1, 2, 3, and 5.

2.4.1 No Project Alternative—Existing and Planned Improvements

NEPA requires the evaluation of a No Action Alternative in an EIS (Council on Environmental Quality Regulations § 1502.14(d)). Similarly, CEQA requires that an EIR include the evaluation of a No Project Alternative (CEQA Guidelines § 15126.6(e)). The No Project Alternative (synonymous with the No Action Alternative) represents the conditions that would occur in the forecast year (in this case, 2040) if the proposed action (in this case, the Bakersfield to Palmdale Project Section) were not built. Specifically, the No Project Alternative reflects the effects of growth planned for the region, as well as existing and planned improvements to the highway, aviation, conventional passenger rail, and freight rail systems in the Bakersfield to Palmdale Project Section area. The No Project Alternative also reflects other reasonably foreseeable development that would occur in the absence of the HSR project through the 2040 time horizon for the environmental analysis.

2.4.1.1 Planned Land Use

From 2010 to 2040, Kern County's population is projected to grow at a higher rate (60.5 percent) than California as a whole (23.8 percent). Los Angeles County is expected to grow at a somewhat slower rate than the state; the county is expected to see a 13.4 percent increase in population. Table 2-5 shows the population, employment, and housing projections for the two counties. The 2040 projections show almost 1.9 million new inhabitants, approximately 663,600 new jobs, and 677,792 housing units in the two counties combined.

Table 2-5 Regional Projected Population, Employment, and Housing

County	Existing Setting (2015)	2040 Projected	Increment and Percent Change
Population[1]			
Kern	880,387	1,413,000[2]	+532,613 (60.5%)
Los Angeles	10,155,069	11,514,000[3]	+1,358,931 (13.4%)
Employment[4]			
Kern	353,600	466,000[2]	+112,400 (31.8%)
Los Angeles	4,674,800	5,226,000[3]	+551,200 (11.8%)
Housing[1]			
Kern	292,774	461,000[2]	+168,226 (57.5%)
Los Angeles	3,487,434	3,997,000	+509,566 (14.6%)

Sources:
[1] California Department of Finance, 2016
[2] Kern Council of Governments, 2015
[3] Southern California Association of Governments, 2016
[4] California Employment Development Department, 2016

Regional Transportation Plan

A blueprint that establishes a set of regional transportation goals, policies, and actions intended to guide the development of planned multimodal transportation systems

In addition to the regional transportation plans (RTP), general plans for cities and counties in the area were reviewed for information about growth and transportation policies in the communities covered. General plans reviewed include those for the Kern and Los Angeles Counties and the Cities of Bakersfield, Tehachapi, Lancaster, and Palmdale. While the newest of these plans—Tehachapi's 2012 General Plan (City of Tehachapi 2012), the draft 2009 Metropolitan Bakersfield General Plan (City of Bakersfield and Kern County 2007), and the Los Angeles County General Plan (County of Los Angeles 2015)—are supportive of HSR, older general plans in the area for the most part do not mention HSR. One exception is the City of Palmdale's General Plan (City of Palmdale 1993); although adopted in 1993, it contains an Objective (C.4.2) to "Encourage extension of passenger rail service to the City of Palmdale" and a Policy (C4.2.1) supporting connecting Palmdale Regional Airport (PMD) with Los Angeles International Airport via HSR.

The No Project Alternative includes several planned transportation, housing, commercial, and other development projects by the year 2040. Some of the notable, larger planned residential projects in the region are listed in Table 2-6. See Appendix 3.19-A, Cumulative Project List, for an expanded list of development projects intended to help accommodate the projected 2040 study area population in the two-county area and transportation projects near the HSR project. Additionally, Section 2.5.1.2 discusses some of the major transportation improvements planned near the HSR project within Kern and Los Angeles Counties.

Although the pending development projects above illustrate the sizes of some of the larger currently anticipated projects, the list does not represent the entire scope of likely or potential development in the study area through the 2040 horizon. The development projects identified in the cumulative project list represent only a portion of the projects that are likely to be built in the study area through 2040 because the list is mostly based on planned development activity over the next 3 or 4 years. The general plans of the cities and counties in the study area include provisions for future growth beyond existing development levels under their land use elements. Additional development projects not included on the cumulative project list are expected to proceed in the future based on general plan land use designations.

Table 2-6 Planned Residential Development Projects within the Bakersfield to Palmdale Project Section Area by 2040

General Location	Project Name	Location (Distance from Alignment)	Planned Number of Dwelling Units	Total Number of Units
Kern County	The Canyons[1]	North side of SR 178, west of Alfred Harrell Highway (4.2 miles)	1,400	14,205
	The Grapevine Project[1]	Tejon Ranch on both sides of I-5 at Grapevine (24.8 miles)	12,000	
	Project No. 13-0066[2]	1006 Baker Street (2.5 miles)	50	
	Tract Map No. 6459[2]	North of Niles Street between Park Drive and Valencia Drive (1.1 miles)	57	
	Tract Map No. 6872[2]	South side of College Avenue between Valencia Drive and Park Drive (1.0 mile)	152	
	Tract Map No. 6297[2]	North of Redbank Road between S Oswell Street and S Sterling Street (0.74 mile)	172 lots remaining of 316 lots	
	Tract Map No. 6554[3]	North of and adjacent to Valley Boulevard, west of and adjacent to Dennison Road, and north of Tehachapi High School (0.65 mile)	95	
	Tract Map No. 6497[3]	North of Highland Road, south of Tehachapi High School, and west of Dennison Road (1.0 mile)	60	
	Tract Map No. 6714[3]	North of and adjacent to Pinon Street, south of Cherry Lane, and east of Tucker Road (2.4 miles)	75	
Los Angeles County	Tract Map No. 47895[4]	Northwest corner of Avenue K-12/Challenger Way (0.30 mile)	24 of 39 homes built	206
	Tract Map No. 54199[4]	Northeast corner of Avenue H-8/5th Street E (0.55 mile)	20 of 55 homes built	
	Tract Map No. 54406[4]	West of 5th Street E and north of Avenue K (0.30 mile)	12 of 21 homes built	
	Tract Map No. 64392[5]	Southeast corner of Challenger Way/Avenue H-12 (1.1 miles)	91	
TOTAL				**14,411**

Sources:
[1] *Murphy, 2016*
[2] *Ortiz, 2016*
[3] *Schlosser, 2016*
[4] *Ng, 2016*
[5] *City of Lancaster, 2013*
I = Interstate
SR = State Route

Regardless of development patterns, population and employment growth would result in increased demand for travel between destinations. The regional measure for growth in travel is daily vehicle miles traveled (VMT). As shown in Table 2-7, between 2005 and 2040, VMT is projected to increase 71.8 percent in the Kern County region; VMT per year in Southern California is projected to increase 73 percent, from approximately 22 million to over 38 million in 2035 (Kern Council of Governments 2014). As shown in Table 2-8, between 2012 and 2040, VMT growth in Los Angeles County would occur at a much lower annual rate (compared to Kern County) of 9 percent under the Baseline Scenario. The Baseline Scenario reflects VMT without implementation of the 2016 RTP/Sustainable Communities Strategy and assumes a continuation of the development trends of recent decades, with local general plans not including the intensified policies regarding growth distribution as promoted in the Plan Scenario (Southern California Association of Governments 2016). Furthermore, the Baseline Scenario represents a future in 2040 in which only the following have been implemented: transportation projects currently under construction or undergoing right-of-way acquisition; transportation programs and projects programmed and committed to in the 2015 Federal Transportation Improvement Program; and/or transportation projects that have already received environmental clearance. The Plan Scenario projects a 0.07 percent decrease in VMT with implementation of the transportation investments and strategies detailed in the 2016 RTP/Sustainable Communities Strategy (which represents future conditions in 2040).

Table 2-7 Total Daily Vehicle Miles Traveled—Kern County

County	2005 Daily VMT (estimate)	2040 Daily VMT (estimate)	Estimated Change in VMT (% over 2005)
Kern	22,236,000	38,197,000	+71.8

Source: Kern Council of Governments, 2014
VMT = vehicle miles traveled

Table 2-8 Total Daily Vehicle Miles Traveled—Los Angeles County

County	2012 Daily VMT (estimate)	2040 Daily VMT (estimate)		Estimated Change in VMT (% over 2012)	
	Base Year	Baseline	Plan	Baseline	Plan
Los Angeles	213,344,500	232,582,800	211,857,600	+9.0	-0.7

Source: Southern California Association of Governments, 2016
VMT = vehicle miles traveled

Desert Renewable Energy Conservation Plan

The California desert has an abundance of solar, wind, and geothermal energy resources that have played and will continue to play a critical role in diversifying the nation's energy supply, addressing climate change, and promoting energy independence in the coming decades. To protect the area and streamline the permitting process, the California Energy Commission, the California Department of Fish and Wildlife, the BLM, and the U.S. Fish and Wildlife Service developed the Desert Renewable Energy Conservation Plan (DRECP) in September 2016, which identifies areas in the desert appropriate for the utility-scale development of wind, solar, and geothermal energy projects. The DRECP, a major component of California's renewable energy planning efforts, will help provide effective protection and conservation of desert ecosystems while allowing the appropriate development of renewable energy projects. The plan identifies specific development focus areas that possess high-quality renewable energy potential, have access to transmission, and are located where environmental impacts can be managed and mitigated.

The DRECP focuses on 22.5 million acres in the desert regions and adjacent lands of seven California counties, including Kern and Los Angeles Counties. The DRECP streamlines renewable energy development while conserving unique and valuable desert ecosystems and providing outdoor recreation opportunities. The BLM signed the Record of Decision approving its Land Use Plan Amendment on September 14, 2016, completing Phase I of the DRECP. The BLM Plan Amendment covers the 10 million acres of BLM-managed lands in the DRECP area and includes land use designations that support the DRECP's overall renewable energy and conservation goals, as well as measures designed to protect other values and uses of the public lands. Phase II of the DRECP will align local, state, and federal renewable energy development and conservation plans, policies, and goals. Phase II also includes coordination with county planning efforts, which is critical because counties have the primary land use and permitting authority on private lands in their counties (California Energy Commission 2017).

Appendix 2-I includes a checklist of the DRECP Land Use Plan Amendment, allowable uses, and management actions (also referred to as Conservation Management Actions [CMA]). CMAs are organized by land use allocation (BLM 2016):

- **Land Use Plan Amendment-wide**—CMAs that apply to activities on all types of land allocations within the La**nd Use Plan Amendment Decision Area, which include lands within the interagency DRECP Plan Area and lands outside of the interagency DRECP Plan Area but within the California Desert Conservation Area.**
- **Ecological and Cultural Conservation—CMAs that apply to activities within California Desert National Conservation Lands, Areas of Critical Environmental Concern, and Wildlife Allocations.**
- **California Desert National Conservation Lands—CMAs that apply only to California Desert National Conservation Lands. Ecological and Cultural Conservation CMAs also apply to these areas.**
- **Areas of Critical Environmental Concern—CMAs that apply to Areas of Critical Environmental Concern. Ecological and Cultural Conservation CMAs also apply to these areas.**
- **Special Recreation Management Areas and Extensive Recreation Management Areas—CMAs that apply to the recreation designations.**
- **Development Focus Areas and Variance Process Lands**—CMAs that apply to areas where renewable energy development is allowed.
- **General Public Lands**—CMAs that apply to lands that do not fall within one of the specified allocations listed above.

The checklist in Appendix 2-I further organizes CMAs by resource (e.g., biological resources, air resources, comprehensive trails and travel management) and indicates whether the CMAs are applicable to the Bakersfield to Palmdale Project Section.

2.4.1.2 Planned Roadway Element

The highway element of the No Project Alternative includes the planned efforts of the Kern Council of Governments and the Southern California Council of Governments to address anticipated growth in VMT and resulting congestion on the roadway system. The No Project Alternative includes the funded and programmed improvements on the intercity highway network based on financially constrained RTPs developed by the two regional transportation planning agencies (Figure 2-49). Table 2-9 and Table 2-10 identify the improvements in Kern and Los Angeles Counties; these tables include map identification numbers that coincide with the numbered improvement projects shown on Figure 2-49.

Source: California High-Speed Rail Authority, 2018

Figure 2-49 Planned Transportation Improvements in Kern and Los Angeles Counties

Table 2-9 No Project Alternative—Planned Improvements in Kern County (near Project Site)

Location/Map No.	Routes	Planned Improvements	Project Timeline
1	SR 184	Widen to four lanes, SR 58 to SR 178	2028
2	SR 58	Build a third lane on the eastbound side of SR 58 along three segments from General Beal Road to SR 202	2024

Source: Kern Council of Governments, 2014
SR = State Route

Table 2-10 No Project Alternative—Planned Improvements in Northern Los Angeles County (near Project Site)

Location/Map No.	Routes	Planned Improvements	Project Timeline
3	Metrolink	Expansion and Improvement to Existing Transit Center in the City of Palmdale	2015
4	SR 18	High Desert Corridor – Construct New Four- to Six-Lane Facility, SR 14 to US-395	2016 to 2040
5	SR 138	NW SR 138 Corridor Improvement Project – Widen SR 138 and provide operational and safety improvements between the I-5 interchange and the SR 14 interchange; PM 0.0 to PM 36.8 on SR 138, PM 79.5 to 83.1 on I-5, and PM 73.4 to 74.4 on SR 14	2016 to 2025

Sources: Southern California Association of Governments, 2014; California Department of Transportation, 2014b; California Department of Transportation and Los Angeles County Metropolitan Transportation Authority, 2016
I = Interstate PM = Post Mile US = U.S. Route
NW = northwest SR = State Route

2.4.1.3 Planned Aviation Element

Bakersfield Meadows Field Airport

Bakersfield Meadows Field Airport (BFL) currently offers the only commercial passenger service in the Bakersfield to Palmdale Project Section area. Located east of SR 99 and north of the City of Bakersfield, it serves more than 700,000 people in or near the Southern San Joaquin Valley. The airport is owned and operated by Kern County and has three carriers providing 11 to 12 daily flights (6 departures and 6 arrivals), with service to Denver, Phoenix, and San Francisco. Two of the daily departures travel within California. In 2015, BFL had 120,966 passenger enplanements.[11]

BFL is beginning a project that will rehabilitate the airport's runways, which will ensure it will be safe and up to Federal Aviation Administration standards and will also help retain current and attract future air service (Meadows Field Airport 2013).

Palmdale Regional Airport

PMD is to the immediate northeast of Palmdale and to the southeast of Lancaster. From 1970 to 1983, the Los Angeles Department of Airports, now called Los Angeles World Airports, acquired approximately 17,750 acres of land east and south of U.S. Air Force Plant 42 in unincorporated Los Angeles County to expand PMD. Los Angeles World Airports did not develop PMD beyond a 9,000-square-foot airport terminal. The airport attracted intermittent commercial service from the 1970s until 2008 (Los Angeles World Airports 2003). In 2009, the City of Palmdale established the Palmdale Airport Authority to carry out and oversee all of the functions and responsibilities of PMD and all other related or necessary actions (City of Palmdale 2009). As Table 2-11 shows, service at PMD ceased in 2008.

[11] An enplanement is a passenger boarding an airplane for departure. A visitor flying in and flying out equals one enplanement.

Table 2-11 Passenger Boardings for Bakersfield and Palmdale Airports

Airport	2005	2010	2015	Change 2005–2010	Change 2010–2015
BFL	146,607	111,699	120,960	-34,908	+9,267
PMD	2,648	0	0	-2,648	N/A
Total	**149,255**	**111,699**	**120,960**	**-37,556**	**+9,267**

Source: Federal Aviation Administration, 2016
BFL = Bakersfield Meadows Field Airport PMD = Palmdale Regional Airport
N/A = not applicable

Table 2-11 summarizes the enplanements at BFL and PMD in the last decade. As Table 2-11 shows, after a decline in passenger usage at BFL during the recent economic downturn, passenger boardings increased from 2010 to 2015. For additional detail on BFL and PMD, see Section 3.2, Transportation.

2.4.1.4 Planned Intercity Transit Element

There is no existing passenger rail service between Bakersfield and Palmdale/Los Angeles County. Amtrak provides intercity passenger rail service in California on three principal corridors: the Capitol Corridor, the Pacific Surfliner, and the San Joaquins. Amtrak operates connecting bus service from the Bakersfield Amtrak Station to Los Angeles Union Station (LAUS) that essentially runs parallel to the Bakersfield to Palmdale Project Section. These buses connect passengers to Amtrak trains in Bakersfield and Los Angeles. Eight scheduled buses are currently provided in each direction of travel every day (Amtrak 2017a, 2017b).

2.4.1.5 Intercity Passenger Bus and Commuter Rail Service

Regional bus service in the study area is provided by Greyhound Bus. Greyhound Bus has bus terminals in Bakersfield and Palmdale in the study area, with scheduled bus service throughout the San Joaquin Valley and Southern California. Greyhound provides daily service from Bakersfield and Palmdale to destinations such as San Jose, San Francisco, Sacramento, Los Angeles, San Diego, and Las Vegas (Greyhound 2017a, 2017b).

Kern Regional Transit provides service throughout Kern County, with connections between Wasco, Shafter, and Bakersfield (Kern Transit 2017). The Golden Empire Transit District provides service throughout the City of Bakersfield and the connecting communities. The Long-Range Transit Plan for the Golden Empire Transit District was completed in 2012 and includes revised intracity routes, intercity bus service expansion, and potential bus rapid transit and light rail transit lines (Golden Empire Transit District and Kern Council of Governments 2012). Continued service is an element of the No Project Alternative, but the Golden Empire Transit District serves only a small portion of the intercity travel market, entirely within Kern County.

In northern Los Angeles County, the Palmdale Station is a multimodal transportation center that serves as a Metrolink rail station, a local bus hub, and a commuter bus hub in the City of Palmdale. It has a waiting area, a café, a public telephone, restrooms, and electronic message boards (Metrolink 2017). The Palmdale Station is also being studied as a possible feeder link between the planned Desert Xpress HSR line to Las Vegas and the California HSR System (Caltrans 2014). A separate proposed project, the High Desert Corridor, would provide HSR service between Victorville and the California HSR System at Palmdale.

The Palmdale Station is served by Metrolink's Antelope Valley Line, which runs from LAUS to Lancaster. Twenty Metrolink trains serve the station each weekday, and 12 trains serve on weekends. Weekday Metrolink service runs primarily at peak hours in the peak direction of travel, while weekend departures and arrivals are more evenly spaced throughout the day (Metrolink 2017).

The Palmdale Station also serves as a hub for the Antelope Valley Transit Authority, the city's local bus system, as well as a hub for its commuter bus network to Los Angeles (Metrolink 2017; Antelope Valley Transit Authority 2015). City of Santa Clarita Transit also serves the station with its commuter bus system to Santa Clarita (Antelope Valley Transit Authority 2016). These local bus systems supplement Metrolink service because the trains go only as far as the stations in Santa Clarita. Greyhound Bus also serves the station, as does Amtrak California Thruway Route 12 bus service connecting with northbound San Joaquin trains in Bakersfield (Metrolink 2017; Amtrak 2016).

2.4.1.6 Planned Freight Rail Element

Two Class I freight railroads (BNSF Railway [BNSF] and UPRR) serve the corridor. These two Class I railroads handle a majority of the state's freight rail traffic and own and operate most of the track mileage (79 percent) in California.

UPRR operates an expansive network of rail lines that serves diverse regions of California, including the agriculturally rich San Joaquin Valley and the Los Angeles metropolitan area. In California, extensive trackage rights arrangements exist between freight carriers as well as track-owning public agencies. For instance, BNSF operates 2,130 miles of track in California. Of this total, BNSF owns 1,155 miles and has access to the remaining 975 miles through trackage rights. While some of this mileage predates the modern era (notably, the Tehachapi corridor between Bakersfield and Mojave), most is more recent, having resulted from the UPRR/Southern Pacific Railroad merger and line sales to public agencies during the 1990s (Caltrans 2013). UPRR's route to Los Angeles goes through Palmdale, then southeast to Colton. The Los Angeles County Metropolitan Transportation Authority owns the former Southern Pacific Railroad line south from Palmdale to Los Angeles via Santa Clarita and uses it for Metrolink service between Lancaster and Los Angeles (Caltrans 2008).

UPRR is the owner and BNSF is the tenant that operates on the Mojave Subdivision, Kern Junction to Mojave (Tehachapi Trade Corridor). The Tehachapi Trade Corridor is the primary freight corridor through the Tehachapi Mountains. Seventy percent of the freight volume transported through this corridor originates in the Central Valley. BNSF has been concerned about capacity constraints and their impact on future freight growth. BNSF routes intermodal trains from the Port of Oakland and Northern California over the Tehachapi Mountains to connect with their TRANSCON mainline in Barstow. This location has also been identified as a constraint to the growth of rail services to the Port of Oakland. The route through the mountains includes steep grades, extreme track curvature, and a single track through the majority of the corridor. Train volumes on this line are high and are projected to approximately double, which will exacerbate existing capacity issues. According to the American Society of Civil Engineers' 2012 Kern County Infrastructure Report Card, the Tehachapi Trade Corridor has a rating of "At Capacity," indicating no room to serve increases in traffic. Improvements on this route have been approved to receive support under California's Trade Corridor Improvement Fund and will include double-tracking, siding extensions, and signal system upgrades (Caltrans 2013).

The State of California has identified the BNSF Railway/UPRR Mojave Subdivision Tehachapi Rail Improvement Project as a critical rail project. The project vicinity is experiencing increased congestion, rail traffic volume, and delays. Rail volumes through the Tehachapi Pass have greatly increased in the past decade due to growth in volume of goods transported through the region. In addition to rail transportation, SR 58 provides the other significant means of access across the Tehachapi Mountains between Central California and states to the east, such as Nevada and Arizona. About 30 percent of the traffic on this portion of SR 58 is truck traffic. Rapid growth in Bakersfield in recent years has also added traffic along major routes going through the Bakersfield metropolitan region to the Mojave area, and this growth is expected to increase. Therefore, the project's goal is to add capacity, provide reliable and efficient freight transportation, and improve the overall movement of goods through the Tehachapi Pass. The project would reduce operational constraints that limit efficiencies of rail freight movement across the Tehachapi Mountains (Caltrans 2012).

2.4.2 Bakersfield to Palmdale Project Section Build Alternatives

Temporary and permanent environmental footprints were developed to inform the analysis of potential environmental project impacts. The temporary environmental footprint areas would be used to support construction activities, including staging, laydown areas, utility relocations, traffic detours, and temporary access roads.

Permanent environmental footprint areas would include dedicated HSR right-of-way for facilities, including aerial track, at-grade track, tunnels, access roads, stations, traction power distribution infrastructure, radio communication sites, and maintenance of infrastructure facilities. Access roads not within HSR right-of-way would require obtaining the necessary right-of-way or a permanent-access easement across private land. The permanent environmental footprint areas also include permanent improvements built in support of the HSR project, such as public roadway improvements, grade separations, and railroad improvements.

The following sections provide an overview and summary of design features that are part of the Bakersfield to Palmdale Project Section, as well as a detailed description of the alignment alternatives.

2.4.2.1 High-Speed Rail Project Impact Avoidance and Minimization Features

The Authority has committed to implementing programmatic impact avoidance and minimization features (IAMF) consistent with the Statewide Program EIR/EIS (Authority and FRA 2005), the Bay Area to Central Valley Program EIR/EIS (Authority and FRA 2008), and the Partially Revised Final Program EIR (Authority 2012f). The Authority would implement these features during project design and construction, as relevant to the HSR project section, to avoid or reduce impacts. These features are considered part of the project and are included in the baseline for the environmental impact analysis. The full text of the IAMFs that are applicable to the project extent is provided in Appendix 2-E. Chapter 3 provides a description of each IAMF as well as its purpose in the context of each resource topic.

- **To Reduce Impacts on Agricultural Lands and Dairy Farms:**
  - AG-IAMF#1: Restoration of Important Farmland Used for Temporary Staging Areas
  - AG-IAMF#2: Permit Assistance
  - AG-IAMF#3: Farmland Consolidation Program
  - AG-IAMF#4: Notification to Agricultural Property Owners
  - AG-IAMF#5: Temporary Livestock and Equipment Crossings
  - AG-IAMF#6: Equipment Crossings
- **To Control Emissions from Construction and Operation**
  - AQ-IAMF#1: Fugitive Dust Emissions (Control)
  - AQ-IAMF#2: Selection of Coatings (Low-Volatile Organic Compound Paint)
  - AQ-IAMF#3: Renewable Diesel
  - AQ-IAMF#4: Reduce Criteria Exhaust Emissions from Construction Equipment
  - AQ-IAMF#5: Reduce Criteria Exhaust Emissions from On-Road Construction Equipment
  - AQ-IAMF#6: Reduce the Potential Impact of Concrete Batch Plants
- **To Reduce Visual Incompatibility**
  - AVQ-IAMF#1: Aesthetic Options
  - AVQ-IAMF#2: Aesthetic Review Process

- **To Address Impacts on Biological Resources**
  - BIO-IAMF#1: Designate Project Biologist, Designated Biologists, Species-Specific Biological Monitors and General Biological Monitors
  - BIO-IAMF#2: Facilitate Agency Access (to Project Site)
  - BIO-IAMF#3: Prepare Water Evaluation and Planning (WEAP) Training Materials and Conduct Construction Period WEAP Training
  - BIO-IAMF#4: Conduct Operation and Maintenance Period WEAP Training
  - BIO-IAMF#5: Prepare and Implement a Biological Resources Management Plan
  - BIO-IAMF#6: Establish Monofilament Restrictions
  - BIO-IAMF#7: Prevent Entrapment in Construction Materials and Excavations
  - BIO-IAMF#8: Delineate Equipment Staging Areas and Traffic Routes
  - BIO-IAMF#9: Dispose of Construction Spoils and Waste
  - BIO-IAMF#10: Clean Construction Equipment
  - BIO-IAMF#11: Maintain Construction Sites
  - BIO-IAMF#12: Design the Project to be Bird Safe
- **To Address Effects on Cultural Resources**
  - CUL-IAMF#1: Geospatial Data Layer and Archaeological Sensitivity Map
  - CUL-IAMF#2: WEAP Training Session
  - CUL-IAMF#3: Pre-Construction Cultural Resource Surveys
  - CUL-IAMF#4: Relocation of Project Features when Possible
  - CUL-IAMF#5: Archaeological Monitoring Plan and Implementation
  - CUL-IAMF#6: Pre-Construction Conditions Assessment, Plan for Protection of Historic Built Resources, and Repair of Inadvertent Damage
  - CUL-IAMF#7: Built Environment Monitoring Plan
  - CUL-IAMF#8: Implement Protection and/or Stabilization Measures
- **To Address Electromagnetic Issues**
  - EMI/EMF-IAMF#1: Preventing Interference with Adjacent Railroad
  - EMI/EMF-IAMF#2: Controlling Electromagnetic Fields/Electromagnetic Interference
- **To Address Geologic Issues and Paleontological Resources**
  - GEO-IAMF#1: Geologic Hazards
  - GEO-IAMF#2: Slope Monitoring
  - GEO-IAMF#3: Gas Monitoring
  - GEO-IAMF#4: Historic or Abandoned Mines
  - GEO-IAMF#5: Hazardous Minerals
  - GEO-IAMF#6: Ground Rupture Early Warning Systems
  - GEO-IAMF#7: Evaluate and Design for Large Seismic Ground Shaking
  - GEO-IAMF#8: Suspension of Operations during an Earthquake
  - GEO-IAMF#9: Subsidence Monitoring

- GEO-IAMF#10: Geology and Soils
- GEO-IAMF#11: Engage a Qualified Paleontological Resource Specialist
- GEO-IAMF#12: Perform Final Design Review and Triggers Evaluation
- GEO-IAMF#13: Prepare and Implement Paleontological Resources Monitoring and Mitigation Plan (PRMMP)
- GEO-IAMF#14: Provide WEAP Training for Paleontological Resources
- GEO-IAMF#15: Halt Construction, Evaluate, and Treat if Paleontological Resources Are Found

- **To Reduce Effects from Hazardous Materials and Wastes**
  - HMW-IAMF#1: Property Acquisition Phase I and Phase II Environmental Site Assessments
  - HMW-IAMF#2: Landfill
  - HMW-IAMF#3: Work Barriers
  - HMW-IAMF#4: Undocumented Contamination
  - HMW-IAMF#5: Demolition Plans
  - HMW-IAMF#6: Spill Prevention
  - HMW-IAMF#7: Transport of Materials
  - HMW-IAMF#8: Permit Conditions
  - HMW-IAMF#9: Environmental Management System
  - HMW-IAMF#10: Hazardous Materials Plans
- **To Reduce Effects on Water Quality and Supply**
  - HYD-IAMF#1: Storm Water Management
  - HYD-IAMF#2: Flood Protection
  - HYD-IAMF#3: Prepare and Implement a Construction Stormwater Pollution Prevention Plan
  - HYD-IAMF#4: Prepare and Implement an Industrial Stormwater Pollution Prevention Plan
- **To Address Effects from Stations and Changes in Land Use**
  - LU-IAMF#1: HSR Station Area Development: General Principles and Guidelines
  - LU-IAMF#2: Station Area Planning and Local Agency Coordination
  - LU-IAMF#3: Restoration of Land Used Temporarily during Construction
- **To Address Noise and Vibration Effects**
  - NV-IAMF#1: Noise and Vibration (Construction and Operation)
- **To Address Effects on Parks and Other Recreation Resources**
  - PK-IAMF#1: Parks, Recreation, and Open Space (Construction and Operation)
- **To Address Effects on Public Utilities and Energy**
  - PUE-IAMF#1: Design Measures
  - PUE-IAMF#2: Irrigation Facility Relocation
  - PUE-IAMF#3: Public Notifications
  - PUE-IAMF#4: Utilities and Energy

- **To Address Safety and Security Effects**
  - SS-IAMF#1: Construction Safety Transportation Management Plan
  - SS-IAMF#2: Safety and Security Management Plan
  - SS-IAMF#3: Hazard Analyses
  - SS-IAMF#4: Oil and Gas Wells
- **To Address Socioeconomic Effects and Effects on Communities**
  - SOCIO-IAMF#1: Construction Management Plan
  - SOCIO-IAMF#2: Compliance with Uniform Relocation Assistance and Real Property Acquisition Policies Act
  - SOCIO-IAMF#3: Relocation Mitigation Plan
- **To Address Transportation and Circulation Effects**
  - TR-IAMF#1: Protection of Public Roadways during Construction
  - TR-IAMF#2: Construction Transportation Plan
  - TR-IAMF#3: Off-Street Parking for Construction-Related Vehicles
  - TR-IAMF#4: Maintenance of Pedestrian Access
  - TR-IAMF#5: Maintenance of Bicycle Access
  - TR-IAMF#6: Restriction on Construction Hours
  - TR-IAMF#7: Construction Truck Routes
  - TR-IAMF#8: Construction during Special Events
  - TR-IAMF#9: Protection of Freight and Passenger Rail during Construction
  - TR-IAMF#10: Off Peak Hour Employee Work Shift Changes at HMF (as applicable to HMF-related sections or the HMF project)
  - TR-IAMF#11: Maintenance of Transit Access
  - TR-IAMF#12: Pedestrian and Bicycle Safety

2.4.2.2 Overview and Summary of Design Features

Alignments and Ancillary Features

Figure 2-1 illustrates the B-P Build Alternatives being evaluated in this EIR/EIS. The impact analysis presented in this EIR/EIS extends from the Bakersfield Station to the Palmdale Station. As noted previously, the Fresno to Bakersfield Project Section documents (including the *Fresno to Bakersfield Section Draft Supplemental EIR/EIS* [Authority and FRA 2017] and *Fresno to Bakersfield Section Final Supplemental EIR* [Authority 2018a] for the LGA) analyze the portion of the alignment from the Bakersfield Station to Oswell Street. That analysis is summarized in this document and is incorporated by reference. The B-P Build Alternatives evaluated herein represent a preliminary level of design and are summarized in Table 2-12. Table 2-13 identifies tunnel portal facilities and infrastructure elements for the proposed Bakersfield to Palmdale Project Section tunnels. Table 2-14 lists proposed traction power locations for the Bakersfield to Palmdale Project Section. Nine paralleling stations, three substations, and one switching station would be located within Kern County for this project section. Two paralleling stations and one switching station would also be located within Los Angeles County.

Table 2-12 Summary of Design Features

Design Features	Alternative 1	Alternative 2	Alternative 3	Alternative 5	CCNM Design Option[1]	Refined CCNM Design Option[2]
Total Length (linear miles)[3]	82.47 miles	82.47 miles	82.45 miles	82.46 miles	+0.02 mile	0.15 mile
Surface Profile (linear miles)	58.41 miles	57.54 miles	57.41 miles	58.40 miles	-0.06 mile	0.37 mile
Elevated Profile (linear miles)	14.30 miles	15.17 miles	13.45 miles	14.30 miles	+0.02 mile	-0.74 mile
Underground Profile (linear miles)	9.76 miles	9.76 miles	11.59 miles	9.76 miles	+0.10 mile	1.30 miles
Number of Straddle Bents	18	32	18	18	+0	-6
Number of Railroad Crossings	2	2	2	2	+0	+0
Number of Major Floodplain Crossings[4]	18	18	18	18	+0	+0
Number of Road Crossings	126	127	125	126	+1	0
Number of Public and Private Roadway Closures[5]	52	52	50	52	+0	0
Number of Roadway Overheads and Underpasses[6]	74	75	75	74	+0	-1

[1] The CCNM Design Option data is applicable to all of the B-P Build Alternatives.
[2] The Refined CCNM Design Option data is applicable to all of the B-P Build Alternatives.
[3] Total length and elevated profile length are measured from the intersection of 34th Street and L Street in Bakersfield to Spruce Court in Palmdale to illustrate features from station to station. Therefore, this includes the F-B LGA portion of the alignment from 34th Street and L Street to Oswell Street, which would be a common alignment for all B-P Build Alternatives.
[4] Major floodplain crossings are Federal Emergency Management Agency floodplain crossings.
[5] Includes closures due to HSR road crossings.
[6] All proposed grade crossing configurations are pending California Public Utilities Commission approval.
B-P = Bakersfield to Palmdale Project Section CCNM = César E. Chávez National Monument HSR = high-speed rail

Table 2-13 Proposed Tunnel Portal Facilities and Infrastructure Elements

Portal Facilities and Infrastructure Elements	Tunnels 1, 2, and 3 (< 0.5 mile)		Tunnel 5 (length varies)		Tunnel 6 (> 0.5 mile; < 1 mile)		Tunnels 4, 7, 8, and 9 (> 1 mile)	
	North Portal	South Portal	North Portal	South Portal	North Portal	South Portal	North Portal	South Portal
Noise Attenuation Hood	X	FA	X	X	X	X	X	X
Portal Ventilation Building	X	NR	X	X	X	X	X	X
Access Road	X	X	X	X	X	X	X	X
Emergency Vehicle Assembly and Turnaround Area	X	X	X	X	X	X	X	X
Rescue Area/Passenger Assembly Area	X	X	X	X	X	X	X	X
Fire Hydrants and Water Supply	X	X	X	X	X	X	X	X
Area Lighting	X	FA	X	X	X	X	X	X
Train Surface Evacuation and Fire Control Zone	X	X	X	X	X	X	X	X
Communication Facilities	X	X	X	X	X	X	X	X
Rock Fall and Debris Containment	X	X	X	X	X	X	X	X

Portal Facilities and Infrastructure Elements	Tunnels 1, 2, and 3 (< 0.5 mile)		Tunnel 5 (length varies)		Tunnel 6 (> 0.5 mile; < 1 mile)		Tunnels 4, 7, 8, and 9 (> 1 mile)	
	North Portal	South Portal	North Portal	South Portal	North Portal	South Portal	North Portal	South Portal
Detention Pond	FA	FA	FA	FA	FA	FA	FA	FA
Parking for Tunnel Maintenance and Traction Power Facilities	X	X	X	X	X	X	X	X
Public Utilities	X	X	X	X	X	X	X	X

Because of the close proximity of Tunnels 1, 2, and 3 to one another, Technical Memorandum 2.4.6 (Authority 2010b) specifies that not all of the proposed portal facilities and infrastructure elements in Table 2-13 are required for the south portal. However, further detailed analysis will verify the need for these facilities, including Authority coordination with local and state fire marshals to confirm that all fire, life, and safety requirements are satisfied without the additional facilities. For Tunnel 6, it is assumed that the tunnel seepage and wastewater and detention pond would be included with the south portal, but future on-site drainage studies will verify the need for these items. All other portal facilities and infrastructure elements are included at all portals.
Authority = California High-Speed Rail Authority NR = Not Required
FA = Further Analysis X = Required

Table 2-14 Proposed Traction Power Locations

Traction Power Facility Types	Number of Stations	County
Paralleling Station	9	Kern
Substation	3	Kern
Switching Station	1	Kern
Paralleling Station	2	Los Angeles
Switching Station	1	Los Angeles

Source: California High-Speed Rail Authority, 2016

A variety of engineering and design refinements have been completed and incorporated into the project plans in Volume 3 of this Final EIR/EIS since the publication of the Draft EIR/EIS. Refinements to the design were considered and incorporated for several reasons, including (1) in response to comments on the Draft EIR/EIS from agencies, stakeholders, and the general public; (2) to further minimize environmental impacts or the necessary footprint area; and (3) to improve safety and reduce costs. These design modifications have been incorporated equally into the design of each alternative, but may vary in some areas where there is more than one alignment alternative. Appendix 3.1-B of this Final EIR/EIS provides a description of the design refinements and the resulting changes in environmental impacts.

Throughout the HSR alignment, refinements were made to improve the design of drainage facilities, cul-de-sacs, typical sections, and other design elements. These refinements also involved associated modifications to the project footprint (both temporary and permanent). Minimizing the footprint reduces the project’s impacts and future right-of-way costs. Most of these refinements reduced the previously defined footprint area. Taking into account all of the modifications described below, the overall footprint area was reduced by approximately 100 acres compared to the footprint studied in the Draft EIR/EIS. Despite the overall reduction in footprint size, several refinements required additional footprint acreage.

The Authority made several design refinements to allow for adjustments in the area of traction power facilities, for consistency with HSR systemwide facility design, and to accommodate an emergency/maintenance access road, as well as to incorporate the relatively flat grade required for a modified HSR profile phase break. These refinements generally resulted in minor additions to the footprint area as previously defined in the Draft EIR/EIS.

Revisions to the design of the relocated Challenger Drive TPSS site also resulted in a modified interconnect run outside the UPRR right-of-way, as well as allowance for an access road around the utility provider substation at Williamson Road (approximately 2 miles east of the HSR alignment) in order to allow access to that interconnect run.

The Caliente Creek TPSS site and associated 6 miles of interconnect run were eliminated from the project design, resulting in a footprint reduction of roughly 72 acres.

The project design was modified throughout its entire length in order to provide rock-slope protection to prevent erosion at drainage outlets and to provide sufficiently sized on-site drainage basins. At all locations, these modifications increased the previously analyzed footprint (ranging anywhere from 3,000 square feet to 350,000 square feet at a given location). At three of these locations, the increase in footprint also accommodated hammerhead turnarounds at HSR viaducts for emergency and maintenance vehicle access.

Minor footprint refinements were made accommodate relocated utilities, including to allow space for relocation of and perpendicular crossing of high-voltage power lines. These adjustments resulted in minor increases in the previously analyzed project footprint.

In the vicinity of Tehachapi Willow Springs Road, the project footprint was increased in order to provide an area of permanent footprint as well as temporary construction easements to accommodate the removal of wind turbines that were determined to be too close to the HSR alignment. The Draft EIR/EIS identified these wind turbines for removal, but the project footprint was not large enough to accommodate the equipment that would be needed to remove them. One engineering refinement realigns Tehachapi Willow Springs Road to the west of the B-P Build Alternatives, adds a connection from Tehachapi Willow Springs Road to the existing dirt Oak Creek Road near the creek, realigns the Pacific Crest Trail (PCT), and replaces the existing at-grade PCT crossing across Tehachapi Willow Springs Road with a grade-separated crossing. This engineering refinement eliminates impacts on a PCT parking area, and the parking area would no longer require relocation as previously described in the Draft Section 4(f) Evaluation in the Draft EIR/EIS. This engineering refinement also replaces the existing at-grade crossing of the PCT across Tehachapi Willow Springs Road with a new grade-separated crossing (Tehachapi Willow Springs Road bridge over the PCT). This engineering refinement would increase safety for PCT users because they would no longer have to cross Tehachapi Willow Springs Road, which has a posted speed limit of 55 miles per hour.

A performance measure of each of the B-P Build Alternatives is the travel time between key destinations. The state-legislated HSR system requirement is to provide for a nonstop service travel time between San Francisco and Los Angeles of 2 hours and 40 minutes, as well as a 2 hour and 20-minute trip between LAUS and Sacramento. Because the B-P Build Alternatives are located along the same general corridor, travel times by alternative are similar. The estimated trip time for the Bakersfield to Palmdale Project Section would be approximately 31.25 minutes going southbound and 27.5 minutes going northbound between Bakersfield and Palmdale.

Station Sites

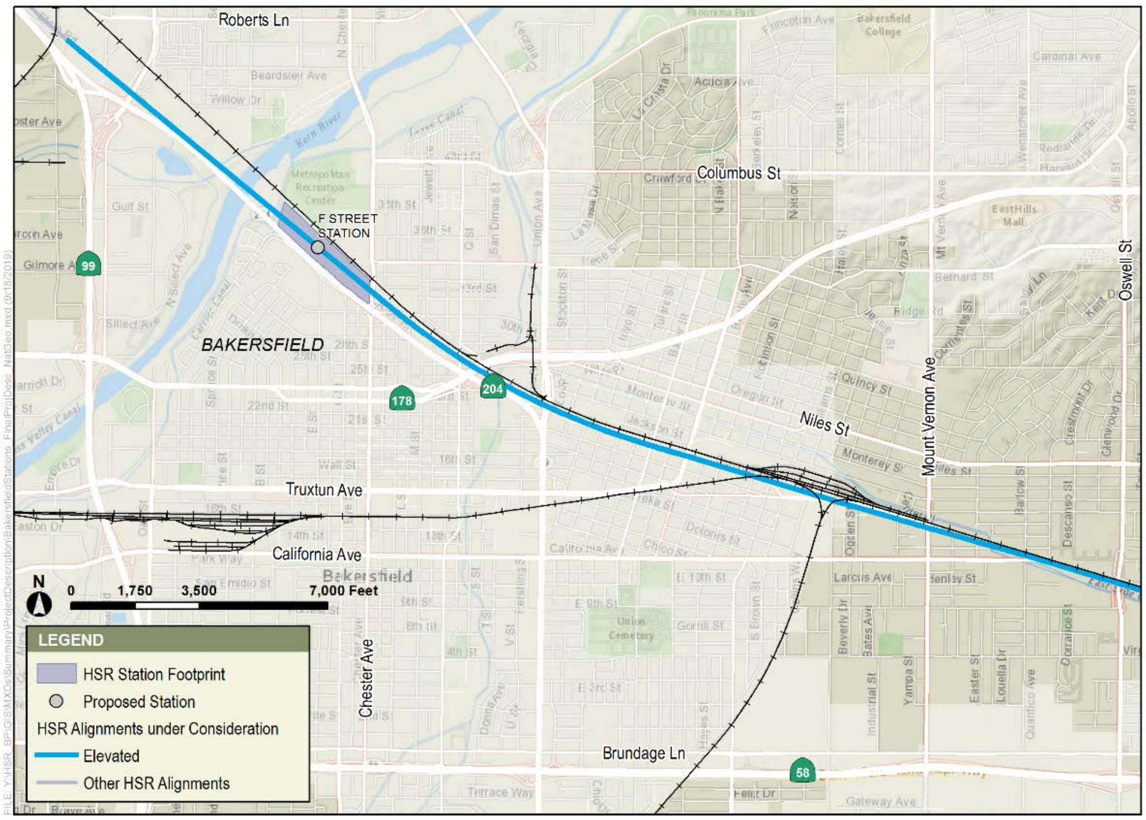
The Bakersfield to Palmdale Project Section would be served by a station in Bakersfield and a station in Palmdale. Stations would be designed to optimize access to the California HSR System, particularly to allow for intercity travel and connections to the local transit, airports, highways, and bicycle and pedestrian network. All stations would include the following elements:

- Passenger boarding platforms
- Station-head house with ticketing, waiting areas, passenger amenities, vertical circulation, administration and employee areas, and baggage and freight-handling service
- Vehicle parking (short-term and long-term)
- Pick-up and drop-off areas
- Motorcycle/scooter and bicycle parking

- Waiting areas and queuing space for taxis and shuttle buses
- Pedestrian walkway connections

Bakersfield Station

In 2014, the Authority and FRA issued the Fresno to Bakersfield Final EIR/EIS, which identified the Bakersfield Station at the corner of Truxtun Avenue and Union Avenue/SR 204 (Authority and FRA 2014) (Figure 2-50 and Figure 2-51). FRA approved the Truxtun Avenue location for the Bakersfield Station in its 2014 Record of Decision for the Fresno to Bakersfield Project Section. Subsequently, the Authority and FRA decided to evaluate an alternate station location at F Street in Bakersfield. This alternate location has been evaluated through a Draft Supplemental EIR/EIS, Final Supplemental EIR, and Final Supplemental EIS for the Fresno to Bakersfield Project Section.



Source: California High-Speed Rail Authority, 2018

Figure 2-50 Bakersfield Station

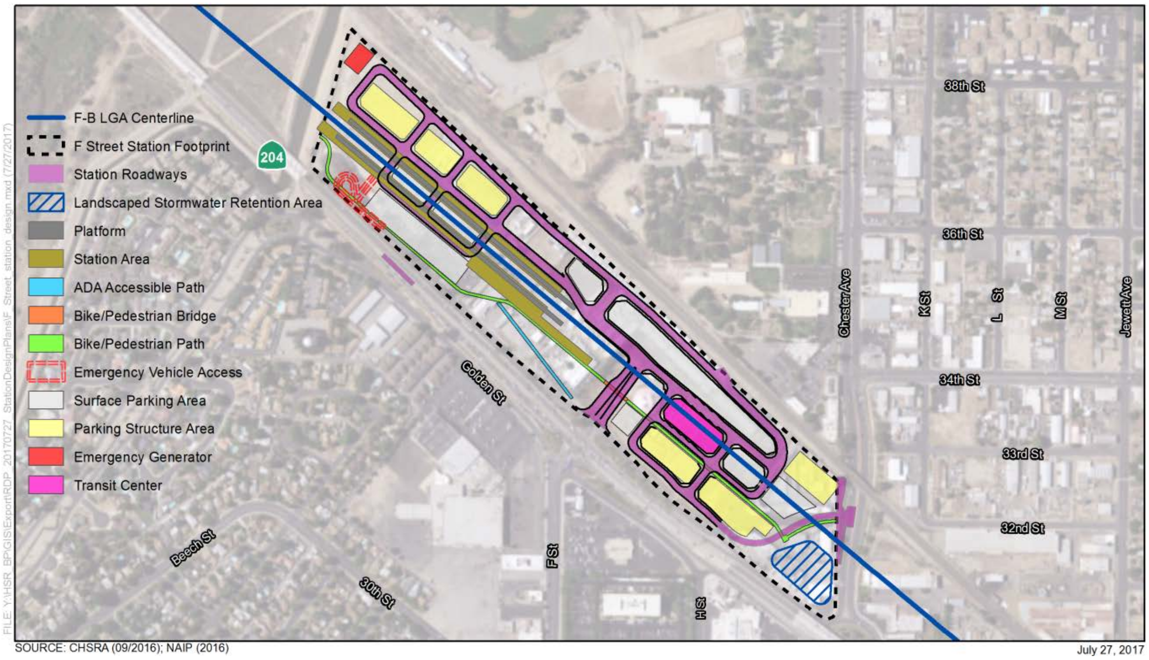


Figure 2-51 Bakersfield Station—F Street (Locally Generated Alternative)

Bakersfield Station—F Street (Locally Generated Alternative)

Since issuance of the 2014 Fresno to Bakersfield Project Section Record of Decision, the Authority and City of Bakersfield agreed to consider an alternate station location at F Street and SR 204, known as the "Locally Generated Alternative." This alternative has been evaluated through a Draft Supplemental EIR/EIS, Final Supplemental EIR, and Final Supplemental EIS for the Fresno to Bakersfield Project Section (Authority and FRA 2017; Authority 2018a; Authority 2019c); the analysis in these documents is incorporated by reference into the Bakersfield to Palmdale Project Section environmental documents pursuant to Section 15150 of the CEQA Guidelines and Section 40 C.F.R. 1506.4 of the NEPA Regulations. In May 2016, the LGA was identified by the Authority's Board of Directors as the Preferred Alternative for inclusion in the Draft Supplemental EIR/EIS.

The Draft Supplemental EIR/EIS for the LGA was released November 9, 2017, for public review and comment. The official comment period began Thursday, November 9, 2017, and ended Tuesday, January 16, 2018. In October 2018, the Authority Board certified the Final Supplemental EIR for the LGA. The Final Supplemental EIS and a Record of Decision were issued by the Authority, under the NEPA Assignment Memorandum of Understanding, in October 2019.

The Fresno to Bakersfield Project Section environmental documents provide analysis for the section terminating at Oswell Street in Bakersfield. That analysis is summarized in this Bakersfield to Palmdale Project Section environmental document and is incorporated by reference.

The Fresno to Bakersfield Section Final EIR/EIS, Final Supplemental EIS for the LGA, Final Supplemental EIR for the LGA, and technical reports supporting the environmental impact evaluation are available upon request.

Palmdale Station

The Palmdale Station would be located along the proposed HSR alignment parallel to the existing rail corridor (Figure 2-52). The existing Palmdale Transportation Center would be expanded to the south to accommodate the HSR system and would be bounded by Technology Drive to the north and Palmdale Boulevard to the south. The Palmdale Station would consist of train platforms, pedestrian walkways/connectors, a transit plaza pick-up/drop-off facility for private automobiles, and surface parking areas. These station facilities would be located on approximately 50 acres.

Train platforms would be built along either side of the proposed HSR alignment, beginning approximately 200 feet south of E Avenue Q. The southbound platform would be west of the southbound tracks, and the northbound platform would be east of the northbound tracks. Each platform would be approximately 1,410 feet long. In addition, the existing Metrolink platform would be replaced by a 700-foot Metrolink platform, which would be built east of the HSR platform, running north-south along the Metrolink railway.

Pedestrian access to the station would be provided through a transit plaza and pedestrian overheads spanning the rail alignments. These overheads would connect the train station/ platforms to surrounding parking areas, which would provide 3,300 potential parking spaces in multiple lots by 2040. The closest parking spots would be located at station entrances, while the farthest parking spots would be within 0.5 mile of a station entrance. Two transit centers, one on either side of the HSR alignment, would house bus terminals for buses and shuttles.

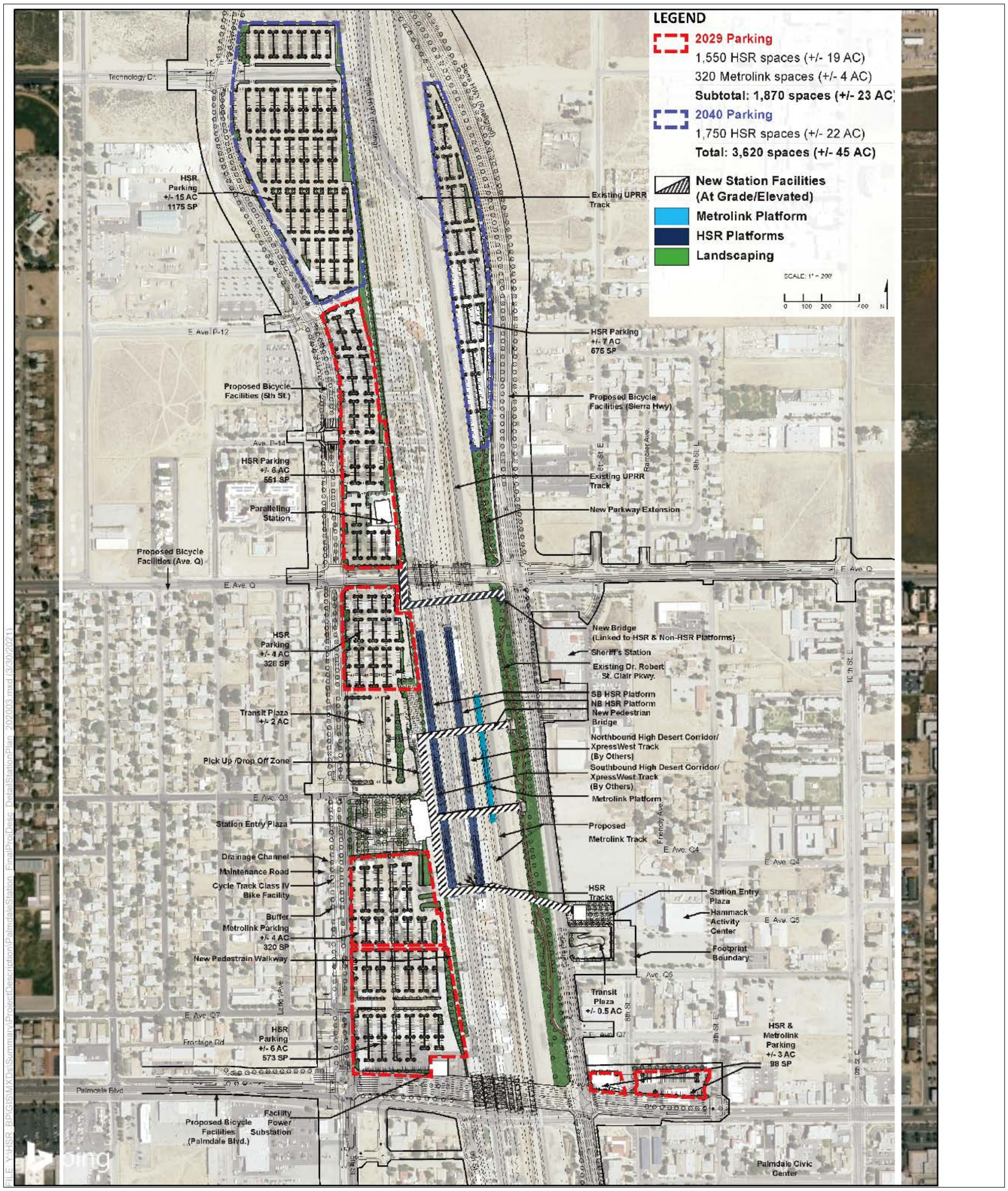
Light Maintenance Facility and Maintenance-of-Way Facility Site Locations

The following three potential double-ended maintenance facility sites were evaluated for the Bakersfield to Palmdale Project Section:

- Lancaster North A
- Lancaster North B
- Avenue M

Figure 2-53 shows the locations of the LMF and MOWF sites being evaluated. As part of the design refinements considered following publication of the Draft EIR/EIS, the Authority revised the design and expanded the project footprint of the Avenue M site in the Cities of Lancaster and Palmdale to accommodate a combined LMF/MOWF. This Final EIR/EIS evaluates the impacts of the combined LMF/MOWF at the Avenue M site. Therefore, the footprint at Avenue M, which was previously only identified as a potential LMF site, has been expanded to accommodate the combined facility. The reasons for the selection of the co-located site as the maintenance facility include (1) the Authority’s requirement for maintenance facilities to have freight rail access for delivery of materials, (2) the southerly location of the MOWF at Avenue M rather than Lancaster North would improve connectivity to the Palmdale Station and HSR project sections to the south of Palmdale, and (3) the Avenue M footprint area is of sufficient size to accommodate an LMF in the future. Although the footprint at the Avenue M site has been expanded by approximately 17 acres to accommodate the potentially combined facility, the Avenue M site requires 177 acres of permanent footprint compared to the Lancaster North LMF/MOWF site, which would have required 212 acres of permanent footprint.

In response to comments made by the City of Tehachapi on the Draft EIR/EIS (refer to Volume 4 of this Final EIR/EIS), the profile of the HSR alignment was lowered (see Section 3.1.2). In order to accommodate this refinement, the MOIS facility site in Tehachapi, near the Tehachapi Willow Springs Road crossing, was shifted from the west side of the alignment to the east side of the alignment.



Source: California High-Speed Rail Authority, 2021

Figure 2-52 Palmdale Station Alternative

Source: California High-Speed Rail Authority, 2020

Figure 2-53 Maintenance Facility Site Alternatives

Lancaster North A

This site is located on the west side of SR 14 and north of W Avenue D, between W Avenue B and W Avenue C. It crosses 35th Street W, Avenue B-12, and 32nd Street W, all of which are unimproved roads. A combined LMF with an MOWF could be accommodated on the Lancaster North A site.

This site offers an acceptable location for housing both the LMF and an MOWF, including lead tracks, due to its size (approximately 210 acres). It lies close enough to the regional road network, generally near the intersection of SR 138 and SR 14 and between Sierra Highway and SR 14, to provide equipment and materials delivery efficiently. The actual site is located between W Avenue B and W Avenue C. W Avenue B and W Avenue C are both two-lane, paved roadways where access to the site can be gained and future utilities could be built to service the site. In addition, overhead power is located along W B Street. The only development on Lancaster North A is a residential area in the northwest corner of the site. Currently, there are no railroad, commercial, or industrial uses on the site. Additionally, the site meets the Authority's design guidelines (TMs 5.3 and 5.1 [Authority 2009c, 2009d]) requiring the LMF site to be positioned alongside the HSR mainline, with connections to and from the mainline, as each end of the lead tracks ties into the HSR mainline at a point where the HSR is an elevated structure. The lead tracks are separate northbound and southbound tracks. As with the mainline, local streets would need to be grade-separated from the lead tracks to the LMF.

Lancaster North B

This site is intended as a maintenance of way-only site to accompany the Avenue M LMF/MOWF site. The potential site is in the same place as Lancaster North A. While Lancaster North A is proposed to accommodate an LMF/MOWF joint facility, Lancaster North B would have a much smaller footprint (approximately 84 acres) because it would accommodate only an MOWF, including lead tracks.

The Lancaster North B site is approximately 15 miles from the Palmdale Station and approximately 10 miles from the Avenue M LMF/MOWF Zone. It lies close enough to the regional road network (generally near the intersection of SR 138 and SR 14 and between Sierra Highway and SR 14) to efficiently provide equipment and materials delivery. It also meets the Authority's design guidelines (TMs 5.3 and 5.1 [Authority 2009c, 2009d]) requiring the MOWF site to be positioned alongside the HSR mainline, with connections to and from the mainline at each end of the site.

Main track access is accomplished through lead tracks on either end of the facility, near single crossovers. The north and south lead tracks tie into the HSR mainline at a point where the HSR is an elevated structure. As with the mainline, local streets would need to be grade-separated from the lead tracks to an MOWF.

Because the Lancaster North B site is a subsite of the Lancaster North A site, the utilities, access, and other physical characteristics are very similar to those described for the Lancaster North A site.

Avenue M

This LMF/MOWF site is on the west side of the HSR alignment and to the west of existing Sierra Highway. The site extends generally between W Avenue L-4 and Avenue O. The proposed location of the LMF/MOWF site is within the boundaries of this area.

Avenue L would be raised with a new roadway overpass and Avenue M would be realigned to the south of its existing location at the crossing with a new flyover roadway bridge. Both would span the MOWF, HSR, Metrolink track, and UPRR track. Avenue N would end in a cul-de-sac west of the lead tracks, but a gate would be provided to allow access over the trenched lead tracks on a new roadway overpass that would be at grade with existing W Avenue N. Access to and from the site is provided on the north side from Avenue L-4 and on the south side from Avenue N. Existing utilities (or potentially future utilities) can service the site. The south end of the site is within the U.S. Air Force Plant 42 Airport boundary, the Flight Zone, and Accident Potential Zones I and II, which could result in safety hazards. The Flight Zone and Accident Potential Zones I and II allow for transportation and rail as compatible uses. Accident Potential Zone I does not allow for passenger terminals or aboveground transmission lines. The site currently has no railroad uses. North of W Avenue M-12, there are currently between 10 and 15 developments. These are mainly commercial establishments, such as motels, restaurants, and business and supply concerns.

This site offers an acceptable location for both the LMF and an MOWF (including lead tracks) due to its size (approximately 230 acres) and proximity to freight rail for delivery of materials. It is also close enough to the regional road network—generally near the intersection of SR 138 and SR 14 and between Sierra Highway and SR 14—to allow efficient delivery of equipment and materials by truck. The site is located between W Avenue L-4 and Avenue O. West Avenue L-4 and Avenue O are two-lane, paved roadways where access roads and utilities could be built to service the site. An LMF/MOWF site located within this zone would be approximately 3 to 4.5 miles from the Palmdale Station. It is adjacent to, and just west of, the HSR mainline and easily connects with the regional road network. It also meets the Authority's design guidelines (TMs 5.3 and 5.1 [Authority 2009c, 2009d]) requiring the MOWF site to be positioned alongside the HSR mainline, with connections to and from the mainline at each end of the site.

The southern lead track providing access to the LMF/MOWF facility ties into the Palmdale Station tracks. Using a tunnel, the northern lead track crosses under the mainline to tie into the station while the southern lead track ties directly to the station at grade. Additionally, the southern lead track alignments avoid conflicts with the potential High Desert Corridor connection. By connecting the southern lead track to the Palmdale Station tracks, the LMF/MOWF facility can be located as close as possible to the station without affecting the High Desert Corridor connection to the HSR. Access to the LMF/MOWF from the mainline in the south would pass through the Palmdale Station tracks. As with the mainline, local streets would need to be grade-separated from the lead tracks to the LMF/MOWF.

At this time, the Authority anticipates the identification and selection of an HMF site built in the Central Valley that would service the entire statewide system. If necessary, the Avenue M LMF/MOWF site in Lancaster could be modified within its current footprint to accommodate a reduced HMF facility that would only service the Bakersfield to Palmdale Project Section and potential projects to the south.

Safety and Security

The system safety and system security program for the development and operation of the HSR system is described in the Authority's Safety and Security Management Plan, which includes the Authority's Safety and Security Policy Statement, roles and responsibilities for safety and security across the project, the program for managing safety hazards and security threats/vulnerabilities, safety and security certification program requirements, and construction safety and security requirements.

Project design would incorporate engineering measures and best management practices based on federal and state regulations and on the Statewide Program EIR/EIS (Authority and FRA 2005). Project design would also adhere to IAMFs listed in Section 3.11, Safety and Security (SS-IAMF#1 through SS-IAMF#4).

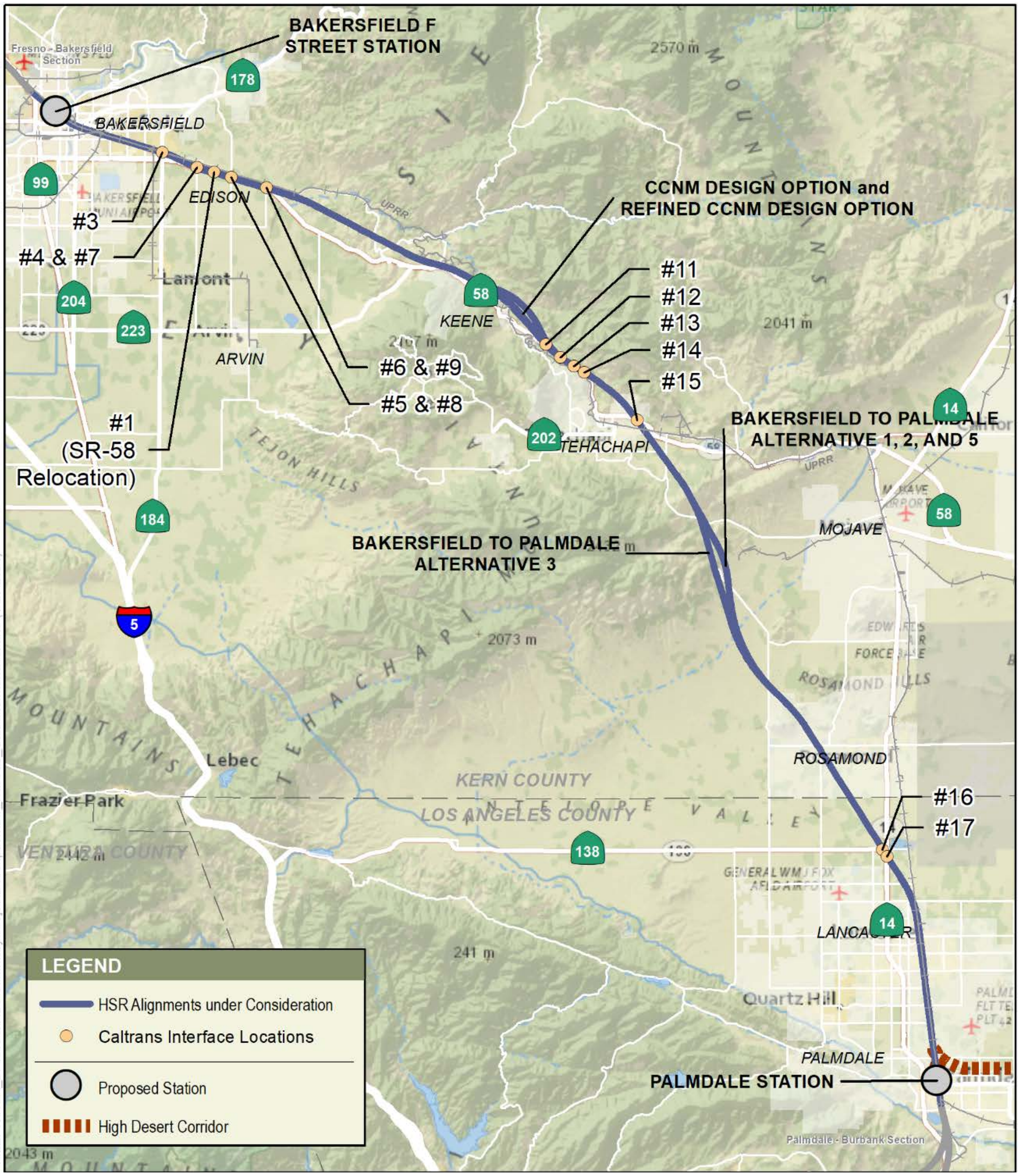
State Highway Modifications

The Bakersfield to Palmdale Project Section is long enough to fall within two Caltrans district boundaries: District 6 and District 7. The district boundary is Avenue A, north of Lancaster. As described below, within District 6, both SR 58 and SR 184 would be affected, and within District 7, SR 138 and SR 14 would be affected. Table 2-15 and Figure 2-54 identify the Caltrans state facilities that would be affected by the HSR system. Technical Appendix 2-A, Road Crossings, Closures, and Detours, provides detailed information for the California Public Utilities Commission to use in its review and authorization of grade separations.

Table 2-15 Bakersfield to Palmdale Project Section Build Alternatives Proposed Modifications to California Department of Transportation State Highway Facilities

No.	District-County-Hwy-PM	Location	Proposed Modifications	B-P Build Alternative(s)
Edison				
1	06-KER-58 (PM 61.2–66.3)	SR 58	Relocation	Alts 1, 3, and 5
3	06-KER-184 (PM 8.4)	SR 184/Weedpatch Highway	Underpass	Alts 1, 2, 3, and 5
4	06-KER-58 (PM 61.5)	SR 58 Edison Road IC	Underpass	Alt 2
5	06-KER-58 (PM 63.5)	SR 58 Comanche Drive IC	Underpass	Alt 2
6	06-KER-58 (PM 65.7)	SR 58 Towerline Road IC	Underpass (eastbound ramps)	Alt 2
7	06-KER-58 (PM 61.5)	SR 58 Edison Road IC	Relocation	Alts 1, 3, and 5
8	06-KER-58 (PM 63.5)	SR 58 Comanche Drive IC	Relocation	Alts 1, 3, and 5
9	06-KER-58 (PM 65.7)	SR 58 Towerline Road IC	Relocation	Alts 1, 3, and 5
Keene				
11	06-KER-58 (PM 85.3)	SR 58 at Broome Road	Underpass	Alts 1, 2, 3, and 5
12	06-KER-58 (PM 86.4)	SR 58 southeast of Marcel	Overhead	Alts 1, 2, 3, and 5
13	06-KER-58 (PM 87.3)	SR 58 between Cable and Marcel	Underpass	Alts 1, 2, 3, and 5
14	06-KER-58 (PM 88.1)	SR 58 north of Cable	Underpass	Alts 1, 2, 3, and 5
Tehachapi				
15	06-KER-58 (PM 93.0)	SR 58 in Tehachapi	Underpass	Alts 1, 2, 3, and 5
Lancaster				
16	07-LA-138 (PM 36.7)	SR 138 west of SR 14	Underpass	Alts 1, 2, 3, and 5
17	07-LA-14 (PM 73.7)	SR 14 south of SR 138	Underpass	Alts 1, 2, 3, and 5

The numbers in the first column correspond to the state facility locations on Figure 2-54.
Alt = Alternative
B-P = Bakersfield to Palmdale Project Section
Hwy = highway
IC = interchange
PM = post mile



Source: California High-Speed Rail Authority, 2018

Figure 2-54 Bakersfield to Palmdale Project Section—State Highway Modifications

Edison (District 6)

Two options are being considered for the B-P Build Alternatives in the Edison area. Alternatives 1, 3, and 5 would relocate existing SR 58 south approximately 200 feet, from just west of Edison Road to just east of Towerline Road, and would run along the north side of the displaced freeway. Alternative 2 would cross over SR 58 at Edison Road and generally follow the freeway on an embankment on the south side of SR 58. Freeway modifications expected for Alternative 2 consist of construction of columns within the freeway cross section and barrier protection.

All B-P Build Alternatives would require ramp modifications. For Alternatives 1, 3, and 5, where SR 58 is proposed to be displaced to the south, three interchanges would need to be rebuilt, at Edison Road, Comanche Drive, and Towerline Road. For Alternative 2, where the HSR would be on an embankment on the south side of the existing freeway, the southern eastbound ramps for the Towerline Road interchange would need to be rebuilt closer to the eastbound SR 58 lanes to fit between the HSR and the existing freeway.

SR 184/Weedpatch Highway/Morning Drive crosses the proposed HSR alignments approximately 2 miles east of Oswell Street. At SR 184 and Edison Highway, the existing facility is a three-lane surface intersection. As referenced in Table 2-15, future plans have SR 184 running north-south and connecting SR 58 to SR 178 via a grade-separated, access-controlled facility. The HSR alignments have been designed to allow SR 184 to go under Edison Highway, the UPRR tracks, and the HSR tracks.

In response to coordination with the Kern Council of Governments and the Greater Bakersfield Separation of Grade District, the HSR profile was lowered in the area of Morning Drive (Weedpatch Highway/SR 184) in Bakersfield, thereby shortening the HSR viaduct structure and realigning Edison Highway in the vicinity of Morning Drive. In addition to a footprint reduction, this modification also represents a design that is preferred by stakeholders and has a reduced construction cost.

Bealville (District 6)

While the B-P Build Alternatives would not directly affect SR 58 near the community of Bealville, all would come within 350 to 450 feet at their closest points and would require a retaining wall alongside the freeway approximately 0.5 mile east of Bealville Road. Additionally, modifications are proposed within the SR 58 right-of-way at the Bealville Road/SR 58 intersection.

Tehachapi Creek Canyon (District 6)

At Broome Road near Marcel and extending approximately 3 miles southeast along SR 58, the B-P Build Alternatives would cross over SR 58 four times. This is due to the alternatives being in a large-radius curve while SR 58 is in a series of smaller curves and straight segments. This stretch of the HSR would consist of viaducts, freeway underpasses, excavated slopes, and embankments.

The relocation of SR 58 in the Marcel area was revised in response to input from Caltrans District 6 to address the minimum desirable slope ratio and to allow for rock-slope protection for cross-drainage (see Volume 4, which includes comment letters).

Freeway modifications expected for three of the crossings would consist of construction of columns within the freeway cross section; barrier protection (such as concrete barriers) to provide protection for nonyielding obstructions, structures, and medians; and metal beam guardrails at hazardous fill slopes that do not provide full, clear recovery zone width.

Freeway modifications near the crossing north of the Golden Hills census-designated place would include an approximately 1-mile-long realignment of SR 58 and a bridge structure built for the freeway to allow the HSR to pass underneath.

City of Tehachapi (District 6)

The southernmost crossing of SR 58 would occur in the City of Tehachapi approximately 0.25 mile east of the existing Dennison Road overhead. This crossing would be an HSR viaduct over SR 58.

Freeway modifications would consist of construction of columns within the freeway cross section and barrier protection.

Lancaster (District 7)

Near the SR 138/SR 14 interchange, the B-P Build Alternatives would cross over each highway at an approximately 45-degree skew. These two crossings would consist of approximately 31-foot embankment approaches and viaducts over the freeways. No freeway modifications are expected. The viaducts would be designed to allow for the roadway concepts described in Caltrans' Transportation Concept Reports, which describe transportation facility needs for a given transportation route or corridor.

Freight or Passenger Railroad Modifications

The Bakersfield to Palmdale Project Section would be in or near, would cross, or would relocate the UPRR alignment through Edison, near Keene, in Tehachapi, and through Lancaster and Palmdale. The project section would displace Metrolink through Lancaster and Palmdale. The UPRR within the Bakersfield to Palmdale Project Section is used for freight transport, while Metrolink is used for passenger service. Appendix 2-B, Railroad Crossings, provides detailed information for the California Public Utilities Commission to use in its review and authorization of grade separations.

Edison

From Oswell Street to SR 184, all the HSR alignments would run parallel to the UPRR. This stretch of the alignments would not directly affect the UPRR tracks; however, there is a grade-separated crossing of a UPRR spur line in Algoso. A grade-separated crossing is proposed where the UPRR crosses SR 184.

Keene

In Keene, near Hart Flat Road, there would be a crossing of the UPRR for all HSR alignments. The HSR guideway would cross over the existing freight rail tracks on a new viaduct and would not disrupt UPRR operations.

Tehachapi

The HSR alignments would cross over the UPRR alignment near Goodrick Drive and E Tehachapi Boulevard. The HSR guideway would cross over the existing freight rail tracks on a new viaduct and would not disrupt UPRR operations.

Lancaster

There are two general alignments in Lancaster: Alternatives 1, 2, and 3, and Alternative 5.

Alternatives 1, 2, and 3 are all the same through Lancaster and would displace the existing UPRR and Metrolink tracks from approximately Avenue G to approximately 0.5 mile north of Avenue L. The HSR, Metrolink, and UPRR tracks would all run parallel through this stretch, allowing the existing Sierra Highway to remain unchanged.

For these alternatives, the Authority would obtain right-of-way from the UPRR and would purchase the land necessary to relocate the UPRR tracks to the east. The Authority would relinquish that land to the UPRR when construction is complete. The construction would occur in sequences to allow for little to no downtime for the UPRR and Metrolink.

Alternative 5 would maintain the Metrolink and UPRR alignments in their existing states from Avenue H through Avenue M; however; the Authority would obtain right-of-way from UPRR. The

HSR alignment would parallel the Metrolink and UPRR alignments to the west. This configuration would displace Sierra Highway and would have minor impacts on UPRR or Metrolink operations.

All the B-P Build Alternatives through Lancaster would involve grade-separating key roadway crossings that are currently surface crossings of the Metrolink and UPRR.

Palmdale

Palmdale begins south of Avenue M. In response to comments on the Draft EIR/EIS from the City of Palmdale, the Authority consulted with the City of Palmdale and modified the local grade separation at Palmdale Boulevard to be an undercrossing, rather than an overcrossing as was identified in the Draft EIR/EIS. The reconfiguration of the grade separation entails adjusting the profile of Palmdale Boulevard, Sierra Highway, and the UPRR and Metrolink track corridor, which in turn requires modifications to the project footprint. For reprofiled portions of Sierra Highway to conform with existing ground levels, the project footprint was expanded to accommodate a portion of E Avenue Q-7 north of Palmdale Boulevard, and a portion of Sierra Highway south of Avenue Q-10 E. In addition, the reconfiguration of the Palmdale Boulevard grade separation would also result in reduction of permanent footprint east of Sierra Highway. The original project footprint included surface parking lots between Sierra Highway and 10th Street. The reconfigured project design no longer includes parking east of Sierra Highway, resulting in reduction of the project footprint at this location, but results in the need to relocate 171 parking stalls and 6 Americans with Disabilities Act-compliant parking stalls that were originally planned along E Palmdale Boulevard between Sierra Highway and 10th Place E. These parking stalls would be replaced by adding spaces to multiple surface lots along 5th Street E, west of the HSR, Metrolink, and UPRR tracks.

2.4.2.3 Detailed Description

The B-P Build Alternatives include four end-to-end alternatives (Alternatives 1, 2, 3, and 5). All four alternatives begin at the intersection of 34th Street and L Street in Bakersfield and end south of the Palmdale Station at Spruce Court, just west of Sierra Highway, in Palmdale. Figure 2-1 shows the alternative alignments. Discussion of the B-P Build Alternative alignments and land use and community modifications is organized from north to south and divided into seven geographic areas: Bakersfield, Edison, Keene, Tehachapi, Mojave, Lancaster, and Palmdale. From the north, this project section would begin at the approved Bakersfield Station[12] and travel south and southeast through the Tehachapi Mountains, then descend into the Antelope Valley where it would terminate at the Palmdale Station in the south. Table 2-16 provides an overview of the proposed design features for each B-P Build Alternative.

Table 2-16 Design Features

Design Features	Alternative	Description
Ancillary Features	Alt 1, 2, 3, and 5	The B-P Build Alternatives include ancillary features such as TPSSs, switching stations, paralleling stations, and electrical interconnections and network upgrades (i.e., substations and substation transmission lines), which are illustrated on Figure 2-51 through Figure 2-58
Stations	Alt 1, 2, 3, and 5	Figure 2-55 shows the location of the potential F Street Station in the Bakersfield area. Figure 2-62 shows the location of the existing station in the Palmdale area. For additional details on the stations, see Section 2.5.2.2, Overview and Summary of Design Features.

[12] Bakersfield Station refers to the approved station location at the northern terminus of the Bakersfield to Palmdale Project Section. As shown on Figure 2-53, this I station location is the F Street Station. In November 2017, the Authority and FRA released the Draft Supplemental EIR/EIS that identified the LGA as the preferred alternative, including the F Street Station. In October 2018, the Authority Board certified the Final Supplemental EIR and approved the LGA through the 34th Street and L Street intersection, including the F Street Station. In October 2019, the Authority issued a Record of Decision and Final Supplemental EIS for the Fresno to Bakersfield LGA. In taking this action, the Authority Board reserved making a decision on the alignment from south of the F Street Station to Oswell Street to its future action on the Bakersfield to Palmdale Project Section.

Design Features	Alternative	Description
Maintenance Facilities	Alt 1, 2, 3, and 5	Figure 2-61 shows the location of the LMF/MOWF site in the Lancaster area. Figure 2-62 shows the location of the double-ended LMF/MOWF zone in the Palmdale area. For additional detail on the maintenance facilities, see Section 2.5.2.2, Overview and Summary of Design Features.
State Highway or Local Roadway Modifications	Alt 1, 2, 3, and 5	The B-P Build Alternatives would result in roadway modifications, including road closures and realignments, and grade separations from the HSR with overheads and/or underpasses. These road modifications are detailed in Appendix 2-A, Road Crossings, Closures, and Detours.
Freight or Passenger Railroad Modifications	Alt 1, 2, and 3	Alternatives 1, 2, and 3 would result in the relocation of the UPRR alignment east of its current location in the Lancaster area. These railroad modifications are detailed in Table 2-B-1 in Appendix 2-B, Railroad Crossings.
Land Use and Community Modifications	Alt 1, 2, 3, and 5	The B-P Build Alternatives would result in the conversion of existing and planned land uses to transportation use and would displace a variety of businesses and community facilities. For additional detail, see Section 3.12, Socioeconomics and Communities. The B-P Build Alternatives would also cross through BLM parcels that are part of the DRECP. Section 2.5.1.1, Planned Land Use, includes a discussion of the DRECP. The Authority would also acquire legal rights to property within a 220-foot exclusion zone around HSR tunnel structures to provide a buffer from drilling and blasting excavation activities. This dimension would be measured from the outside of tunnel structures.

Alt = Alternative
Authority = California High-Speed Rail Authority
B-P = Bakersfield to Palmdale Project Section
BLM = U.S. Bureau of Land Management
DRECP = Desert Renewable Energy Conservation Plan
HSR = high-speed rail
LMF = light maintenance facility
MOWF = maintenance-of-way facility
TPSS = traction power substation
UPRR = Union Pacific Railroad

Alternative 1

Bakersfield Area

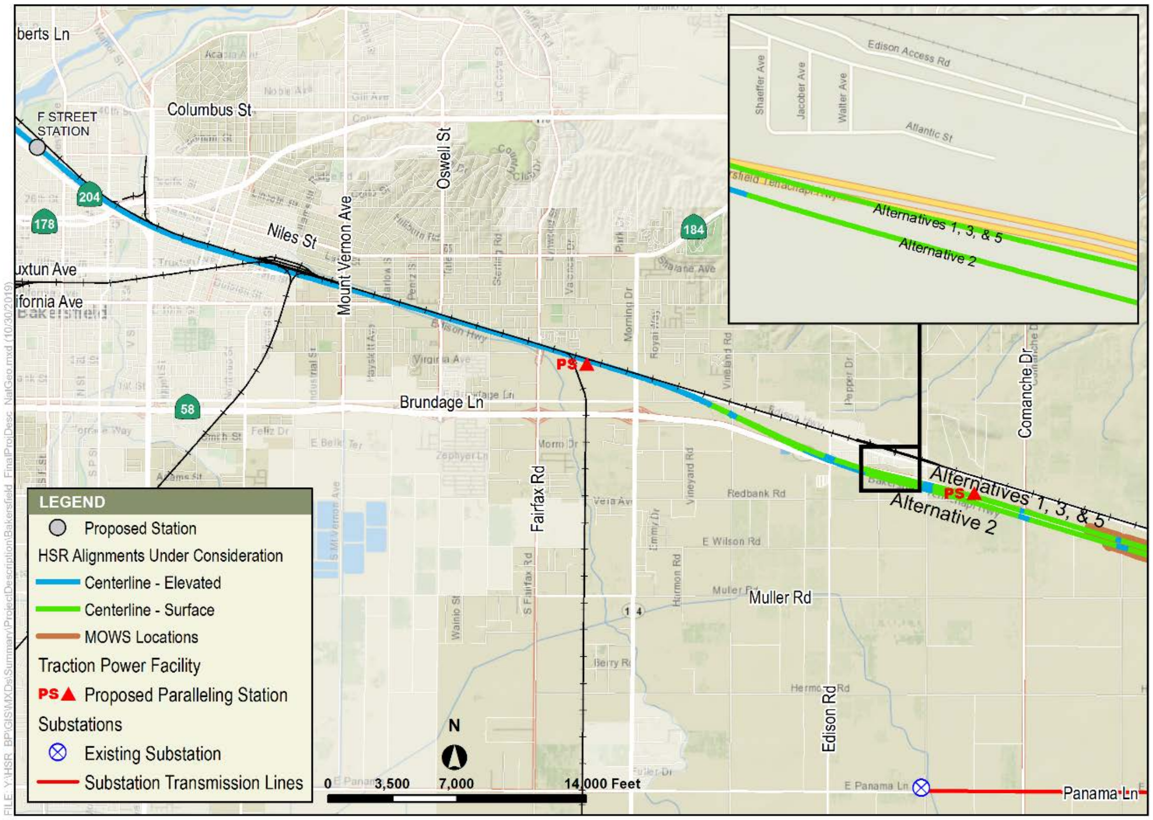
Alignment and Ancillary Features

Figure 2-55 shows the alternative alignments and ancillary features in the Bakersfield area. As shown on the figure, Alternative 1 would begin at the Bakersfield Station on a viaduct (approximately 60 feet in height), and from Oswell Street to Morning Drive (SR 184), the alignment centerline would be located on the north side of Edison Highway. East of Morning Drive, the Alternative 1 alignment would transition from the Edison Highway corridor to the SR 58 corridor, reaching the freeway corridor at Edison Road. Once clear of the Edison Highway right-of-way, the Alternative 1 profile would stay elevated on an embankment or fill section averaging 35 feet in height. At Edison Road, the freeway would be relocated approximately 280 feet to the south, allowing the HSR alignment to run within the existing freeway right-of-way, parallel to the relocated SR 58 alignment along the north side.

In response to coordination with, and comments from, the Greater Bakersfield Separation of Grade District, the design of Morning Drive (SR 184) in Bakersfield (see Section 3.1.2.1) was changed to allow better traffic circulation and to avoid an impact on an AT&T facility (see Volume 4, which includes comment letters).

Land Use and Community Modifications

Alternative 1 would pass through predominantly industrial and commercial areas between Oswell Street and S Vineland Road. Alternative 1 would pass through agricultural and vacant land from S Vineland Road as it travels into the Edison area. The alignment would displace residential units and businesses, including a mix of retail and food service, and industrial uses. For more detail, see Section 3.12, Socioeconomics and Communities.



Source: California High-Speed Rail Authority, 2020

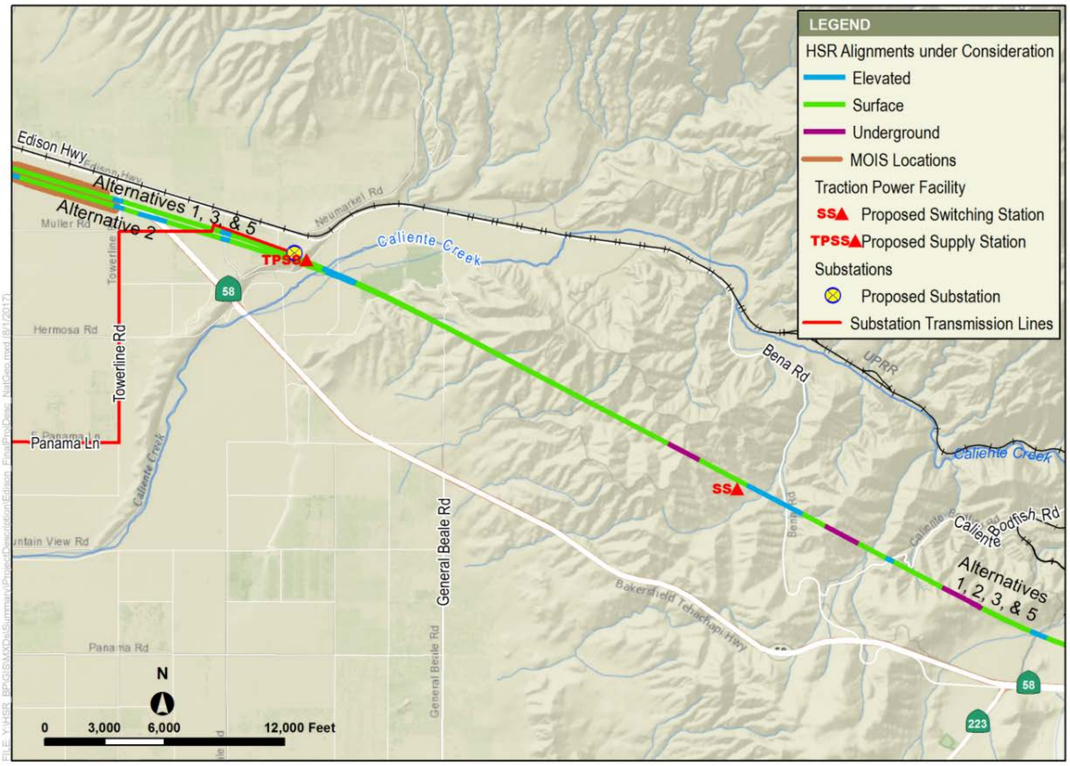
Figure 2-55 Bakersfield Area Detail Map

Edison Area

Alignment and Ancillary Features

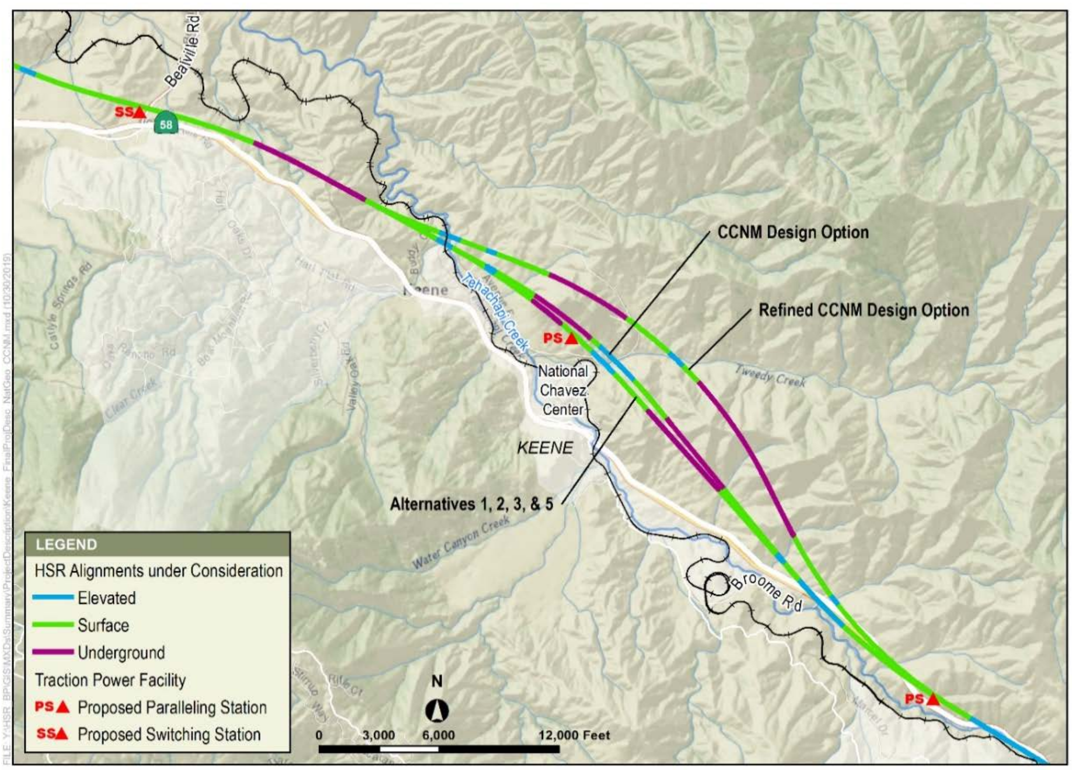
Figure 2-56 shows the alternative alignments and ancillary features in the Edison area. The Alternative 1 alignment would proceed eastward on an embankment or fill section (ranging between approximately 10 and 25 feet in height) along the existing SR 58 alignment to Towerline Road, where the relocated freeway would tie back into existing SR 58 as it heads southward away from Edison Highway. The HSR alignment would continue eastbound parallel to Edison Highway toward Caliente Creek.

From Caliente Creek to Bealville Road (Figure 2-57), Alternative 1 would roughly follow the existing Tejon Ranch Conservancy easement boundary and begin to climb the Tehachapi Mountains at a 2.8 percent vertical grade. The alignment would include a combination of cut sections, fill sections, tunnels, and viaducts before reaching Bealville Road. Alternative 1 would proceed on an embankment that is approximately 150 feet in height and a viaduct over Caliente Creek that is approximately 160 feet in height. As the alignment continues south up the hill, the cut sections would undulate back and forth, ranging from approximately 60 to 300 feet in height as various draws and ridges are crossed. Alternative 1 would cross Bena Road on a viaduct that reaches up to approximately 210 feet in height over the canyon. The alignment would also cross Caliente Bodfish Road and an access road. Alternative 1 would also pass through three tunnels approximately 1,500, 1,630, and 2,000 feet in length in this area.



Source: California High-Speed Rail Authority, 2020

Figure 2-56 Edison Area Detail Map



Source: California High-Speed Rail Authority, 2020

Figure 2-57 Keene Area Detail Map

Land Use and Community Modifications

Alternative 1 would pass through agricultural and vacant land in the Edison area. For more detail, see Section 3.12, Socioeconomics and Communities.

Keene Area

Alignment and Ancillary Features

As shown on Figure 2-57, east of Bealville Road, the alignment would generally follow SR 58 south to the SR 58 interchange with Broome Road. The alignment would cross a canyon just north of Bealville Road on embankments ranging between approximately 30 and 150 feet in height. Between Bealville Road and Broome Road, the alignment would include cut sections, fill sections, tunnels, and viaducts. The cut sections in this area would range between 0 and 160 feet in height, while the fill sections range between approximately 0 and 120 feet in height. Alternative 1 would also cross through three tunnels approximately 6,000, 1,750, and 5,250 feet in length in this area. The viaducts would span the UPRR alignment and Tehachapi Creek, an access road, Tweedy Creek approximately 400 feet northeast of La Paz, another access road, and SR 58 at Broome Road. These viaducts would range from approximately 40 to 160 feet in height.

Land Use and Community Modifications

Alternative 1 would pass through predominantly undeveloped areas in the Keene area. For more detail, see Section 3.12, Socioeconomics and Communities.

Tehachapi Area

Alignment and Ancillary Features

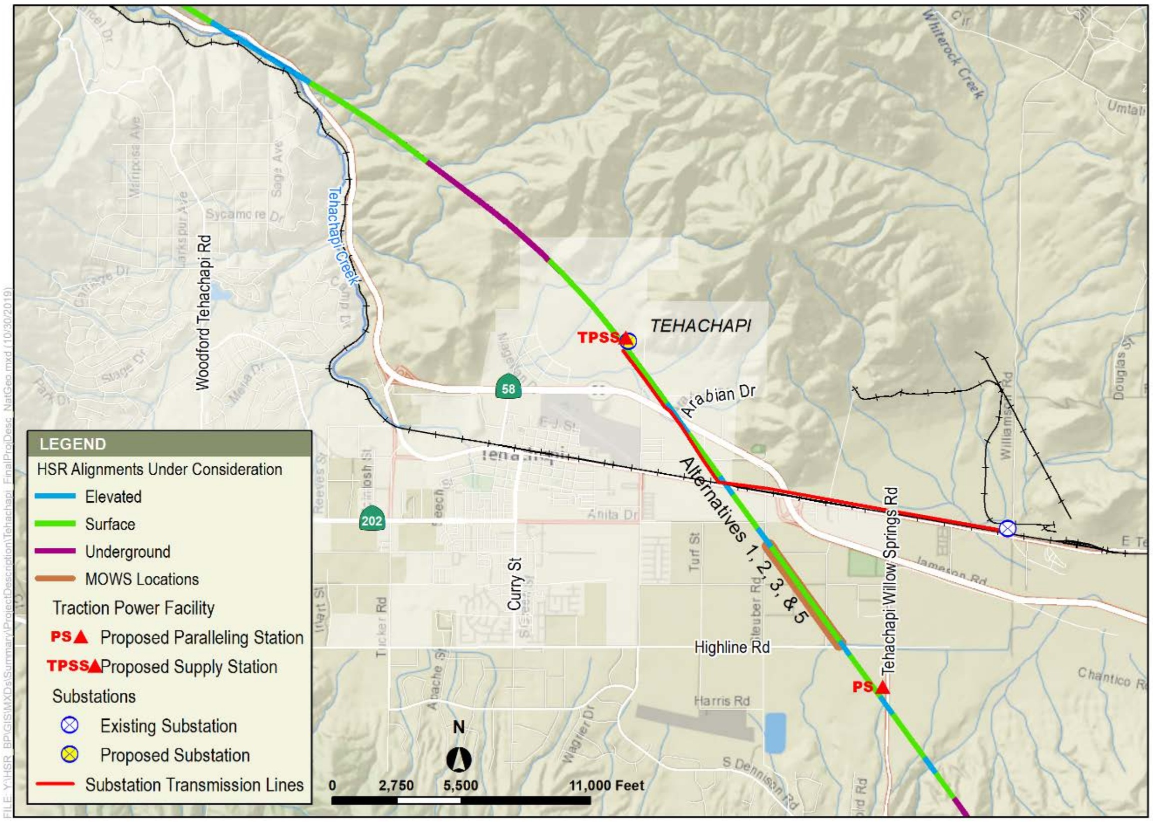
Figure 2-58 shows the alternative alignments and ancillary features in the Tehachapi area. As shown on Figure 2-57, east of the SR 58/Broome Road interchange, for a distance of almost 3 miles, Alternative 1 would include cut sections and fill sections, and it would cross SR 58 three times on viaducts as the two facilities form a braided configuration within the Tehachapi Creek canyon. A few of these cut sections would be on steep side slopes with heights reaching up to 500 feet. As SR 58 turns south approaching the City of Tehachapi, Alternative 1 would continue on an easterly path, along the edge of the city's future development area through an approximately 8,200-foot tunnel. The alignment would then curve farther south and pass to the east of the city, crossing SR 58 near Arabian Drive. Alternative 1 would cross the Tehachapi Valley on an embankment or fill section averaging 50 feet in height, crossing local roads on viaducts.

The Authority revised several access roads, including adjustment of the access road that ties into Voyager Drive in north Tehachapi, connection of the HSR access road to Challenger Drive in Tehachapi, and provision of an access road from the relocated paralleling station to Tehachapi Willow Springs Road. Each of these revisions increases the project footprint compared to what was analyzed in the Draft EIR/EIS.

In response to comments made by the City of Tehachapi on the Draft EIR/EIS, the revised design lowered the HSR alignment. As a direct result of the lowered profile, two existing roadways that would have passed under the HSR on a viaduct structure (Highline Road and Tehachapi Willow Springs Road) would now cross over the HSR alignment. This adjustment resulted in an overall footprint reduction due to the lower profile of the HSR alignment from near the south portal of Tunnel 7, north of the City of Tehachapi, extending through Tehachapi, and returning to the original profile at the southern portal of Tunnel 8. Additionally, the realignment of Valley Boulevard was needed to tie into Steuber Road, maintaining the existing traffic circulation patterns.

Several other modifications to the design were made in response to comments from the City of Tehachapi on the Draft EIR/EIS. These revisions include adding an access road around the tunnel portal just northeast of the Adventist Health Tehachapi Valley facility, revising tunnel portal grading in the same general area, and shifting the Challenger Drive TPSS site to a location north of the alignment. The change of the TPSS site location also shifted the access road and the interconnect needed at the site.

In response to a comment from the City of Tehachapi, a bridge to allow connectivity from Challenger Drive/Dennison Road to the east side of the HSR alignment was added to the design, where construction of a development is planned.



Source: California High-Speed Rail Authority, 2020

Figure 2-58 Tehachapi Area Detail Map

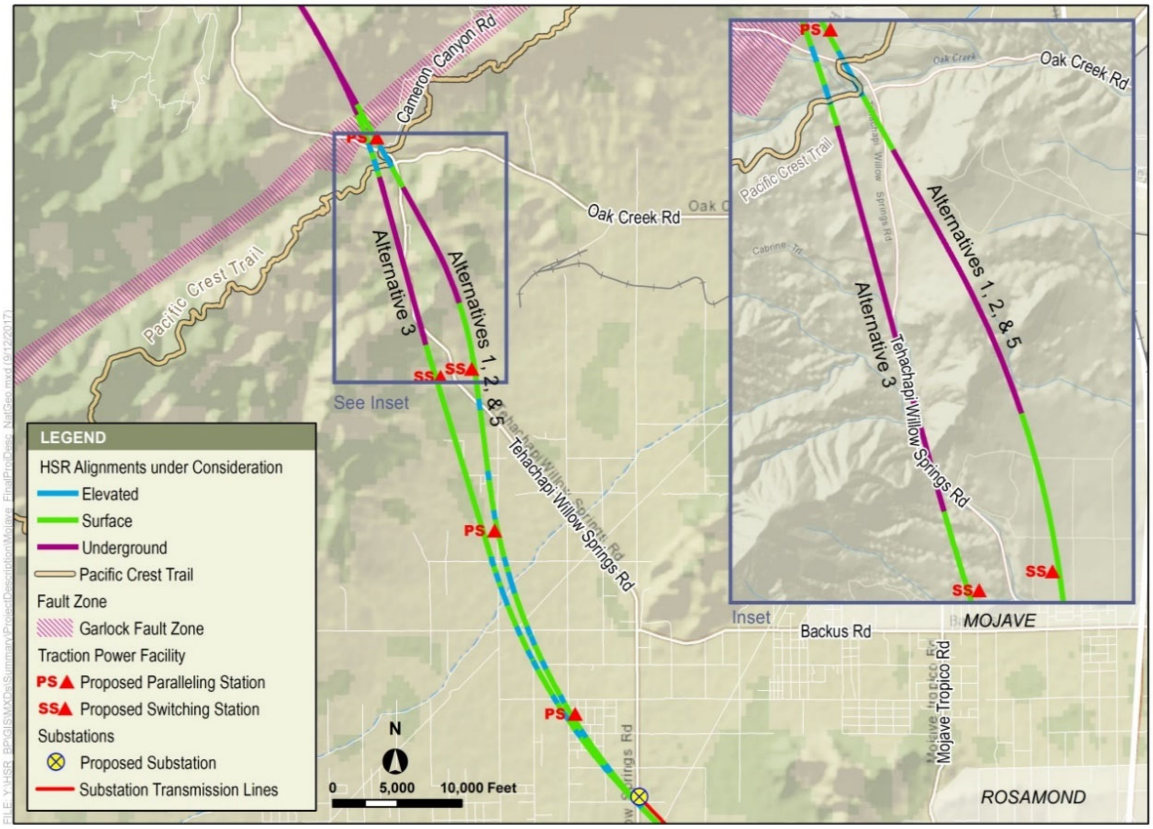
Land Use and Community Modifications

Alternative 1 would pass through undeveloped areas in eastern Tehachapi. From there, Alternative 1 would pass through predominantly industrial, agricultural, and vacant land before descending into the Antelope Valley. The alignment would displace residential units and businesses, including a mix of light industrial and warehouse uses. For more detail, see Section 3.12, Socioeconomics and Communities.

Mojave Area

Alignment and Ancillary Features

Figure 2-59 shows the alternative alignments and ancillary features in the Mojave area. Alternative 1 would pass through the mountains southeast of Tehachapi in an approximately 13,250-foot tunnel roughly following Tehachapi Willow Springs Road. The alignment would pass just west of the CalPortland Cement Company's existing limestone quarry in an approximately 9,500-foot tunnel, then continue southeast toward the community of Rosamond on an embankment or fill section that is approximately 30 feet in height. In response to a comment on the Draft EIR/EIS from CalPortland Cement Company indicating that the north portal of Tunnel 9 (located immediately south of the PCT crossing and Oak Creek Road) was located within the potential flyrock zone of their active mining operations, the project design for Alternatives 1, 2, and 5 was revised to provide for construction of a cover extending 1,700 feet from the northerly terminus of Tunnel 9 to protect the HSR infrastructure from the potential for damage from flyrock (flyrock is rock that is ejected from the blast site in a controlled explosion in mining operations). Alternative 3 is not within the flyrock zone for CalPortland's mining operations; therefore, this design refinement was not made to Alternative 3 in this area.



Source: California High-Speed Rail Authority, 2020

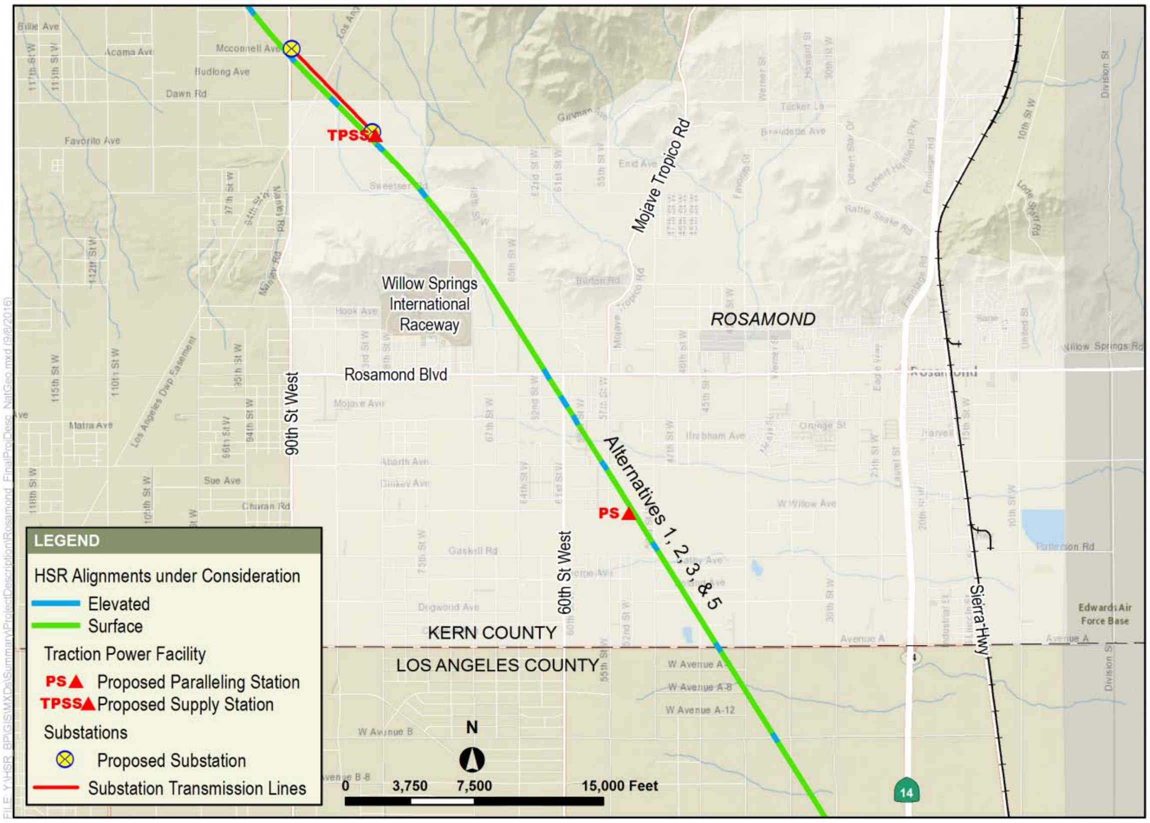
Figure 2-59 Mojave Area Detail Map

Land Use and Community Modifications
Alternative 1 would pass through predominantly agricultural and undeveloped areas in the Mojave area. For more detail, see Section 3.12, Socioeconomics and Communities. As the alignment passes near the CalPortland Cement facility, an exclusion zone to protect HSR infrastructure (which would be a minimum distance of 220 feet from the HSR alignment centerline) would be established around both sides of the HSR alignment. No blasting activities from CalPortland or any other owners would be permitted within this exclusion zone.

Rosamond Area

Alignment and Ancillary Features
As shown on Figure 2-60, Alternative 1 would continue on an embankment or fill section that is approximately 30 feet in height, crossing local roads on viaducts. The alignment would travel southeast past the east side of Willow Springs International Raceway, where it would proceed across Rosamond Boulevard toward the north end of Los Angeles County, into the City of Lancaster.

Land Use and Community Modifications
Alternative 1 would pass through predominantly agricultural and undeveloped areas, as well as some rural residential land uses in the Rosamond area. The alignment would displace residential units in Rosamond. For more detail, see Section 3.12, Socioeconomics and Communities.



Source: California High-Speed Rail Authority, 2020

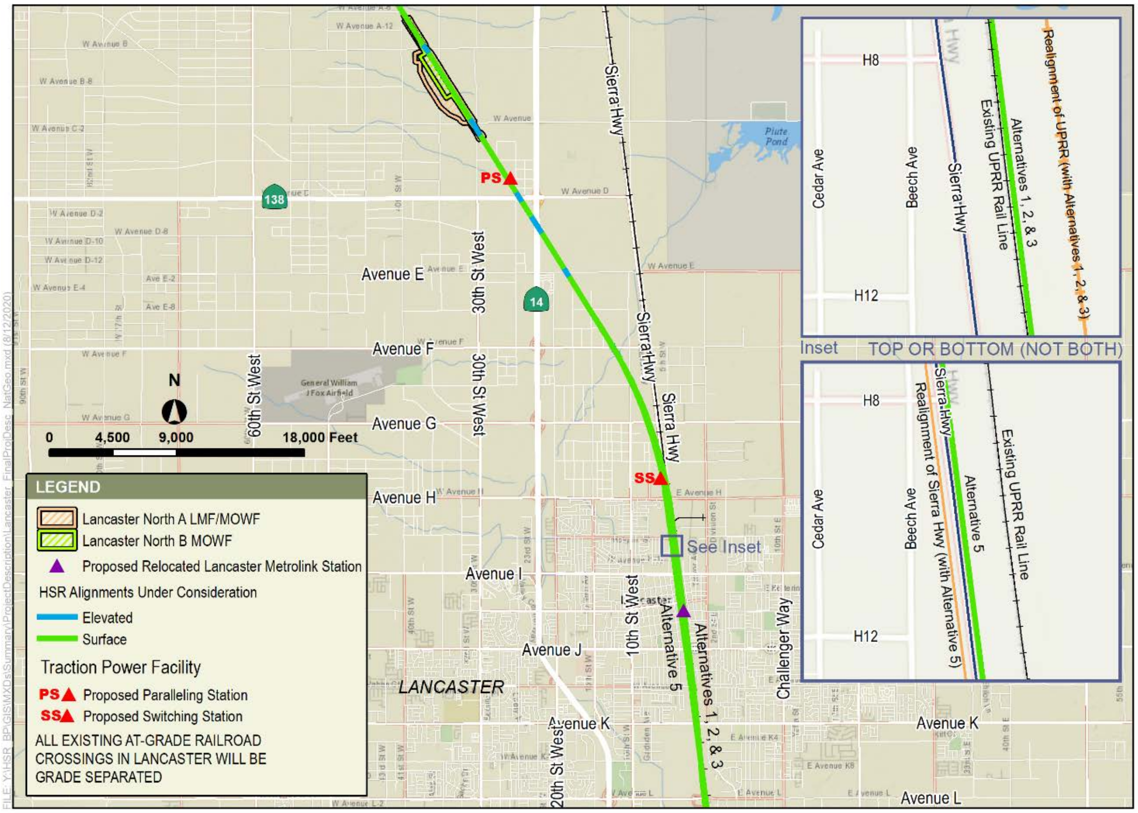
Figure 2-60 Rosamond Area Detail Map

Lancaster Area

Alignment and Ancillary Features

Figure 2-61 shows the alternative alignments and ancillary features in the Lancaster area. Alternative 1 would be on an embankment or fill section that is approximately 30 feet in height. Alternative 1 would pass over SR 138 and SR 14 near their interchange and over other local roads on viaducts. The alignment then would enter the City of Lancaster at Avenue H, running parallel to the Sierra Highway/UPRR corridor through Lancaster and Palmdale. From Avenue H through the City of Lancaster, Alternative 1 would combine the HSR, UPRR, and Metrolink rail corridors into one combined corridor. Under Alternative 1, the new combined rail corridor would be placed as close as possible to the easterly edge of existing Sierra Highway and then widened approximately 220 feet to the east to accommodate all three rail systems. The alternative would require the relocation of the UPRR and Metrolink facilities in the corridor from north of Avenue H to approximately Avenue L (see Table 2-B-1 in Appendix 2-B, Railroad Crossings). In response to comments from the City of Lancaster, modifications were made to the design at the W Avenue H/7th Street W intersection to allow for the relocation of an existing driveway to the parking lot at the northeast corner of that intersection.

The alternative would create separate rights-of-way for the UPRR and Metrolink rail corridors to the east of the HSR right-of-way. Therefore, Alternative 1 would align east of Sierra Highway and west of the UPRR corridor.



Source: California High-Speed Rail Authority, 2020

Figure 2-61 Lancaster Area Detail Map

In response to comments on the Draft EIR/EIS from the City of Lancaster, some modifications were made to roadway crossings within the city limits. As described in the Draft EIR/EIS, W Lancaster Boulevard would be closed between the intersection of Sierra Highway and the UPRR tracks, and the HSR alignment would be located between Sierra Highway and the UPRR. Milling Street would be connected across the HSR and UPRR alignments by a new roadway overpass spanning Beech Avenue, Sierra Highway, the HSR alignment, the Metrolink and UPRR tracks, and Yucca Avenue. However, after evaluation of comments on the Draft EIR/EIS by the City of Lancaster, the Authority refined the design to retain the connectivity of Lancaster Boulevard as an underpass across the rail corridor. With the connection at Lancaster Boulevard, the connection of Milling Street across the HSR alignment is no longer proposed.

Additionally, W Avenue I, as described in the Draft EIR/EIS, would have been grade-separated with an overpass spanning Sierra Highway, the HSR alignment, and the UPRR tracks, and further modifications would have retained access between W Avenue I and Sierra Highway via signalized intersection. Per the request of the City of Lancaster, the design of the W Avenue I crossing has been modified to become an underpass rather than an overpass. As part of the design modifications at W Avenue I, the footprint at the underpass has been reduced to avoid a low-income housing development in the immediate vicinity.

Land Use and Community Modifications
Alternative 1 would pass through predominantly industrial and commercial land uses as well as some residential uses in the Lancaster area. The alignment would displace residential units and businesses, including a mix of retail and food services, auto-related businesses, professional businesses, and various light industrial and warehouse uses. Alternative 1 would permanently

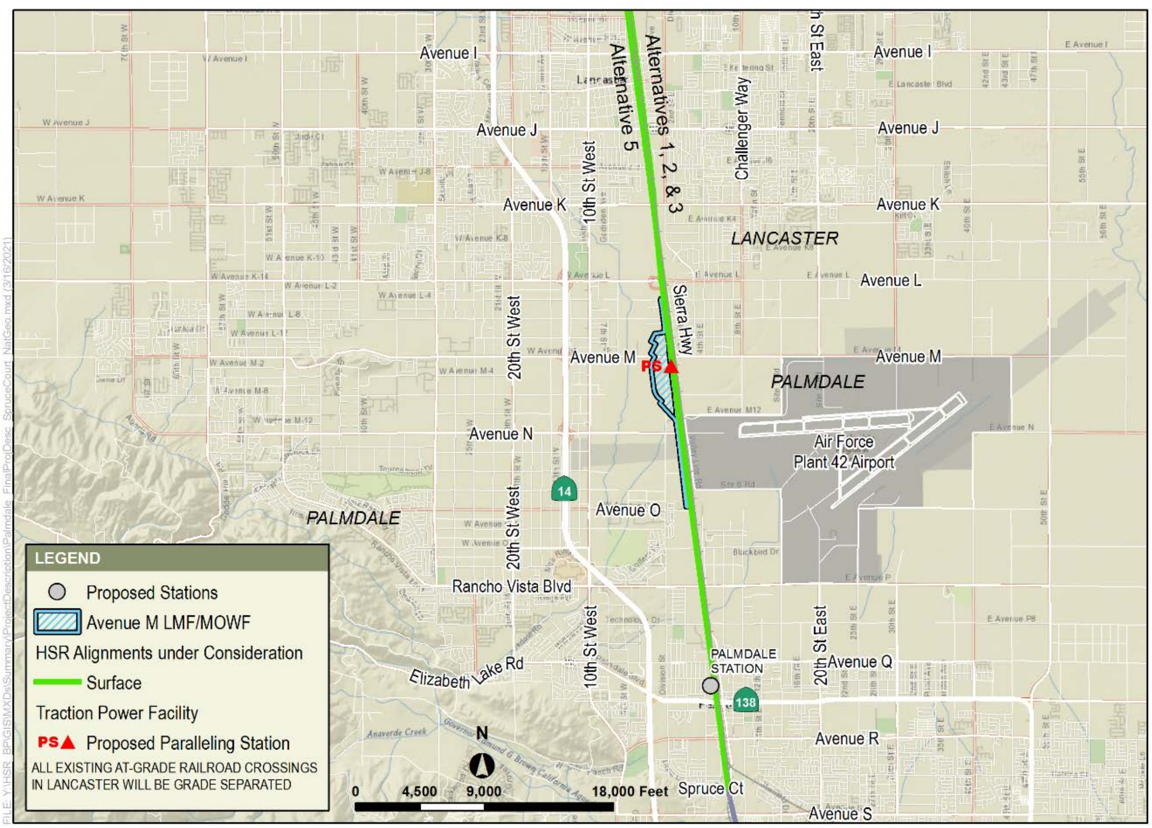
affect community facilities in the Lancaster area, and it would result in the displacement of the Grace Resource Center. For more detail, see Section 3.12, Socioeconomics and Communities.

Under Alternative 1, the Lancaster Metrolink station would be relocated to accommodate the HSR tracks. The existing station building would be replaced with a new structure approximately 400 feet north of its current location. The existing Metrolink platforms would be relocated approximately 180 feet east and 400 feet north of its existing location. The Metrolink parking lot and station building would be connected to the relocated platform via an ADA-compliant pedestrian underpass that would pass beneath the HSR tracks and the relocated Metrolink and UPRR tracks.

Palmdale Area

Alignment and Ancillary Features

As shown on Figure 2-62, to avoid airspace restrictions from the U.S. Air Force Plant 42 Airport to the south, the alignment would begin a transition to the west at Avenue K. It would continue this transition to Avenue M, where the HSR alignment would be situated west of the existing UPRR/Metrolink right-of-way, which would remain in its existing location. The HSR alignment would then continue south, parallel to and along the westerly side of the existing rail corridor, until the section terminus at the Palmdale Station, located at the Palmdale Transportation Center. The westerly transition of the alignment, from Avenue K to Avenue O, would require the relocation of approximately 4.5 miles of Sierra Highway to the west. Preliminary routes for this highway relocation would vary between 500 feet and 2,900 feet west of its existing location. This would provide a separation of 500 feet to 2,800 feet between the rail corridor and the highway. The alignment would end at the Palmdale Station.



Source: California High-Speed Rail Authority, 2020

Figure 2-62 Palmdale Area Detail Map

Land Use and Community Modifications
Alternative 1 would pass through predominantly industrial and commercial land uses as well as some residential uses in the Palmdale area. The alignment would displace residential units and businesses, including a mix of retail and food services, auto-related businesses, professional businesses, and various light industrial and warehouse uses. For more detail, see Section 3.12, Socioeconomics and Communities.

2.4.2.4 Comparison of Bakersfield to Palmdale Project Section Build Alternatives

The following sections describe how Alternatives 2, 3, and 5 vary from Alternative 1 as described above. Additional information comparing the alternative alignments is presented in Chapter 8, Preferred Alternative and Station Site(s). Additional information comparing the impacts on environmental resources by alternative is included in Chapter 3 and summarized in Table 8-1, Comparison of Bakersfield to Palmdale Project Section Build Alternatives, in Section 8.3.1.1.

Alternative 2

Alignment and Ancillary Features

Alternative 2 would follow the same alignment from Bakersfield to Palmdale as Alternative 1 except through the community of Edison. Figure 2-55, Figure 2-56, and Figure 2-57 show the alternative alignments through the community of Edison. Alternative 2 would vary from Alternative 1 between Edison Road and Towerline Road, where the HSR alignment would run along the south side of existing SR 58 on an elevated embankment ranging between 40 and 45 feet in height. Under Alternative 2, SR 58 would remain in its current alignment, but this alternative would require an elevated structure for the HSR spanning the SR 58/Edison Road interchange diagonally. Another elevated structure crossing back over SR 58 would be necessary just past Towerline Road, and three additional elevated structures would be needed to cross the HSR over existing north-south roads (Malaga Road, Comanche Drive, and Tejon Highway) spaced approximately 1 mile apart between Edison Road and Towerline Road. Alternative 2 is the only B-P Build Alternative that would not require the relocation of SR 58 in the Edison area.

Land Use and Community Modifications

Alternative 2 would generally result in the same land use and community modifications as discussed under Alternative 1. However, Alternative 2 would be located farther from key community resources (i.e., Edison Middle School, low-income housing, and agricultural packing houses) in the Edison area than Alternative 1, which would reduce impacts from noise, vibration, and access.

Alternative 3

Alignment and Ancillary Features

Alternative 3 would follow the same alignment from Bakersfield to Palmdale as Alternative 1 except along the southern base of the Tehachapi Mountains. In the area shown on Figure 2-58, Alternative 3 varies from Alternative 1 just south of Tehachapi in the vicinity of the CalPortland Cement Company quarry, where the alignment would travel closer to Tehachapi Willow Springs Road. The alignment would cross Tehachapi Willow Springs Road farther west but still near the Cameron Canyon Road intersection.

These two most southerly tunnels, while in the same general location as Alternative 1, would consist of one approximately 13,500-foot tunnel and another approximately 13,000-foot tunnel, in contrast to Alternatives 1, 2, and 5, which would each consist of one approximately 12,700-foot tunnel and another approximately 9,500-foot tunnel. The additional tunnel lengths of Alternative 3 would create 10 million cubic yards of excess hauling material. South of Tehachapi, Alternative 3 would split off in a more westerly direction than Alternative 1 until it reconnects at the common connection point of Alternative 1, approximately 17 miles south of Tehachapi.

Land Use and Community Modifications

Alternative 3 would generally result in the same land use and community modifications as discussed under Alternative 1, with the exception that Alternative 3 could result in more of an impact on future mining areas than Alternative 1.

Alternative 5

Alignment and Ancillary Features

Alternative 5 would follow the same alignment from Bakersfield to Palmdale as Alternative 1 except in the City of Lancaster. Figure 2-61 and Figure 2-62 show the alternative alignments in the Lancaster and Palmdale areas, respectively. Between Avenue H and Avenue M in the City of Lancaster, Alternative 5 would be situated west of the existing UPRR and Metrolink facilities, avoiding the need to relocate them. The exception to this would be the Lancaster Metrolink station building and parking facilities, as discussed further below under Land Use and Community Modifications. Sierra Highway would need to be relocated up to approximately 3,100 feet for approximately 8.5 miles. The highway would be relocated west of the HSR alignment except for when it reconnects to the existing Sierra Highway at Avenue G to the north and Avenue P-14 to the south.

Land Use and Community Modifications

Alternative 5 would generally result in the same land use and community modifications as discussed under Alternative 1. However, Alternative 5 would also displace the Los Angeles County Sheriff's Department Lancaster Station, the Iglesia de Cristo, and the University of Antelope Valley.

While Alternative 5 would also relocate the Lancaster Metrolink station to accommodate the HSR tracks, these impacts would vary among Alternatives 1, 2, and 3. Alternative 5 would not result in the displacement of the Metrolink station platforms or track. Under Alternative 1, the existing station building would be replaced with a new structure approximately 120 feet north of its current location, instead of approximately 400 feet as identified for Alternative 5. Additionally, under Alternative 5, the existing Metrolink station parking areas between Sierra Highway and the UPRR tracks would be removed and replaced with a new surface parking lot to the west of the relocated Sierra Highway. The northeastern corner of the new Metrolink parking lot would be connected to the relocated station via an ADA-compliant pedestrian underpass that would pass beneath the relocated Sierra Highway and the HSR tracks.

Alternative 5 would also reconfigure the existing surface parking lot for the Antelope Valley Union High School District administrative offices to replace parking lost as a result of the Sierra Highway relocation. Additional replacement parking for the Antelope Valley Union High School District offices would be provided in a small surface parking lot south of Milling Street.

2.4.2.5 CCNM Design Option

Alignment and Ancillary Features

Figure 2-57 shows the CCNM Design Option and alternative alignments in the Keene area. The CCNM Design Option's termini are identical for all of the alignment alternatives. The CCNM Design Option's northern terminus would be north of SR 58 at Buddy Court, and its southern terminus would be northwest of Marcel Drive and SR 58. Similar to the alignment alternatives, the CCNM Design Option would generally follow SR 58 south to the southern terminus. The CCNM Design Option would also include cut sections, fill sections, tunnels, and viaducts within the Keene area. The cut sections in this area range between 0 and 225 feet in height, while the fill sections range between approximately 0 and 110 feet in height. The CCNM Design Option would also pass through two tunnels approximately 3,320 and 4,300 feet in length in this area. The viaducts would span the UPRR alignment and Tehachapi Creek, an access road, Tweedy Creek, another access road, and SR 58 near Broome Road, on structures ranging from approximately 0 to 160 feet in height. At its closest proximity to La Paz, the CCNM Design Option would be approximately 850 feet northeast of La Paz, compared to 400 feet for the alignment alternatives.

To further reduce anticipated direct visual and audible adverse effects, a noise barrier would be added to the bridge structure to minimize project noise to a level that is considered to have no effect per FRA guidelines, and some combination of vegetative screening and coloring and/or texturing of the bridge structure could be introduced. Additionally, areas of ground disturbance would be recontoured and revegetated to minimize the visual effects associated with the earthwork required to construct the project.

Land Use and Community Modifications

The CCNM Design Option would generally result in the same land use and community modifications as discussed under Alternative 1.

2.4.2.6 Refined CCNM Design Option

In response to concerns expressed by consulting parties between June 2017 and February 2019, the Authority has developed 10 design options that either avoid or minimize adverse effects to the National Historic Landmark. In 2019, the Authority issued the *Design Options Screening Report for the César E. Chávez/Nuestra Señora Reina de la Paz National Historic Landmark* (Authority 2019a) and the *Addendum to the Design Options Screening Report for the César E. Chávez/Nuestra Señora Reina de la Paz National Historic Landmark* (Authority 2019b), which evaluate 10 potential design options developed to avoid or minimize impacts on La Paz. This process resulted in the Refined CCNM Design Option for the project section.

The analyses presented in the screening report and addendum were based on a mapped centerline for the alignment of each design option and not a project footprint. The analyses were based on common north-south endpoints for the B-P Build Alternatives and design options to ensure that the length of a design option would not skew the potential impact results.

The techniques used to gather information and to develop and compare the design options include the following:

- **Qualitative Assessment**—Several qualitative measures to evaluate the design options were developed, including constructability, accessibility, operations and maintenance, public infrastructure impacts, railway infrastructure impacts, and environmental impacts.
- **Quantitative Engineering Assessment**—Engineering assessments were provided for several measures that can be readily quantified at this stage of project development. The engineering assessments provided information on project length, project cost, and configuration of key features of the alignment, such as the presence of existing infrastructure and geologic considerations (e.g., faults).
- **Quantitative Environmental Analysis Using Geographic Information Systems Technology**—Analysis was performed using geographic information system (GIS) data, which enables analysis of the project's interactions with a variety of measurable geographic features in both natural and built environments. The use of GIS data helped to quickly analyze the effectiveness of the design options to avoid and minimize potential impacts on farmland, water resources, floodplains, wetlands, threatened and endangered species, cultural resources, current urban development, infrastructure, and other resources.
- **Field Assessment**—Where possible based upon authorized permission to enter properties, the design options were the subject of field inspection to identify conditions and factors not visible in aerial photographs or maps. These conditions and factors include those related to aesthetics and visual quality and to noise. Photographs taken at key viewpoints on the La Paz property were used to develop visual simulations, and noise-level measurements were taken at six long-term monitoring locations in proximity to the existing freight train corridor.

Alignment and Ancillary Features

Figure 2-57 shows the Refined CCNM Design Option within the vicinity of La Paz. As shown on Figure 2-57, the Refined CCNM Design Option would begin 180 feet east of Bealville Road in Keene and would begin at-grade for 1.15 miles and then continue underground for about 1.04 miles. The Refined Design Option would transition to at-grade for 0.81 mile and cross an access road and the UPRR on a 0.17-mile-long viaduct. The Refined CCNM Design Option would then continue east at grade for 0.30 mile, cross over an existing access road on a 0.06-mile-long viaduct, then transition back to at grade for 0.59 mile where the Refined CCNM Design Option would transition underground for 0.80 mile. The Refined CCNM Design Option would then emerge where it would pass La Paz. The Refined CCNM Design Option would be 0.53 mile north of La Paz at its closest proximity when it emerges from the tunnel.

While passing La Paz, the Refined CCNM Design Option would be at grade for 0.57 mile at a distance ranging from 0.53 mile to 0.73 mile from the boundary of La Paz before crossing a 0.13-mile viaduct over Tweedy Creek and a local access road. The Refined CCNM Design Option would travel at grade for approximately 0.25 mile before going underground in a 1.7-mile-long tunnel. The Refined CCNM Design Option would then transition to at grade for 0.71 mile before crossing over an access road for 0.06 mile and returning to at grade for 1.71 miles. The Refined CCNM Design Option would then go over SR 58 and Tehachapi Creek on a 0.89-mile-long viaduct, then transition back to at grade for 0.87 mile before entering a tunnel for 1.68 miles. The Refined CCNM Design Option would emerge from the tunnel north of the City of Tehachapi at grade for 1.48 miles before finally ending in a 0.13-mile-long viaduct, where it would tie back into the B-P Build Alternatives at SR 58 in the City of Tehachapi.

To further reduce anticipated direct (visual and audible) adverse effects of the Refined CCNM Design Option on La Paz, an approximately 1,700-foot berm would be at the same level as the catenary for the track. The berm would be an average of 80 feet in height from the existing ground in order to minimize project noise to a level that is considered to have no effect per the FRA guidelines in *High-Speed Ground Transportation Noise and Vibration Impact Assessment* (FRA 2012 guidance manual) (FRA 2012). Figure 2-63 shows a cross section of the HSR alignment and proposed berm in the vicinity of La Paz. Additionally, areas of ground disturbance would be recontoured and revegetated to minimize the visual effects associated with the earthwork required to construct the project.

The B-P Build Alternative alignments would achieve a balanced earthwork condition by use of varying slope ratios; all excavations would be placed within the project limits as embankment. With the addition of the Refined CCNM Design Option, the earthwork balance would not be achievable due to profile changes and would result in a range of about 2 to 14 million cubic yards of excess materials, depending on which of the B-P Build Alternative alignments the Refined CCNM Design Option is coupled with. Those materials would be stockpiled in the area north of SR 58 in the vicinity of Bealville Road, where additional footprint has been identified and is shown on Figure 2-64. The stockpiled materials would be cut slope excavation and tunnel construction spoils. These materials would be similar to materials excavated throughout the Bakersfield to Palmdale Project Section and could be either processed into soils or conglomerates or be left in the condition they are pulled out of the ground (ripped and dumped). The duration that the materials would be stockpiled at this location is currently unknown; therefore, in the environmental impact analyses provided in Chapter 3 of this EIR/EIS, the impacts at this stockpile site are considered permanent impacts.

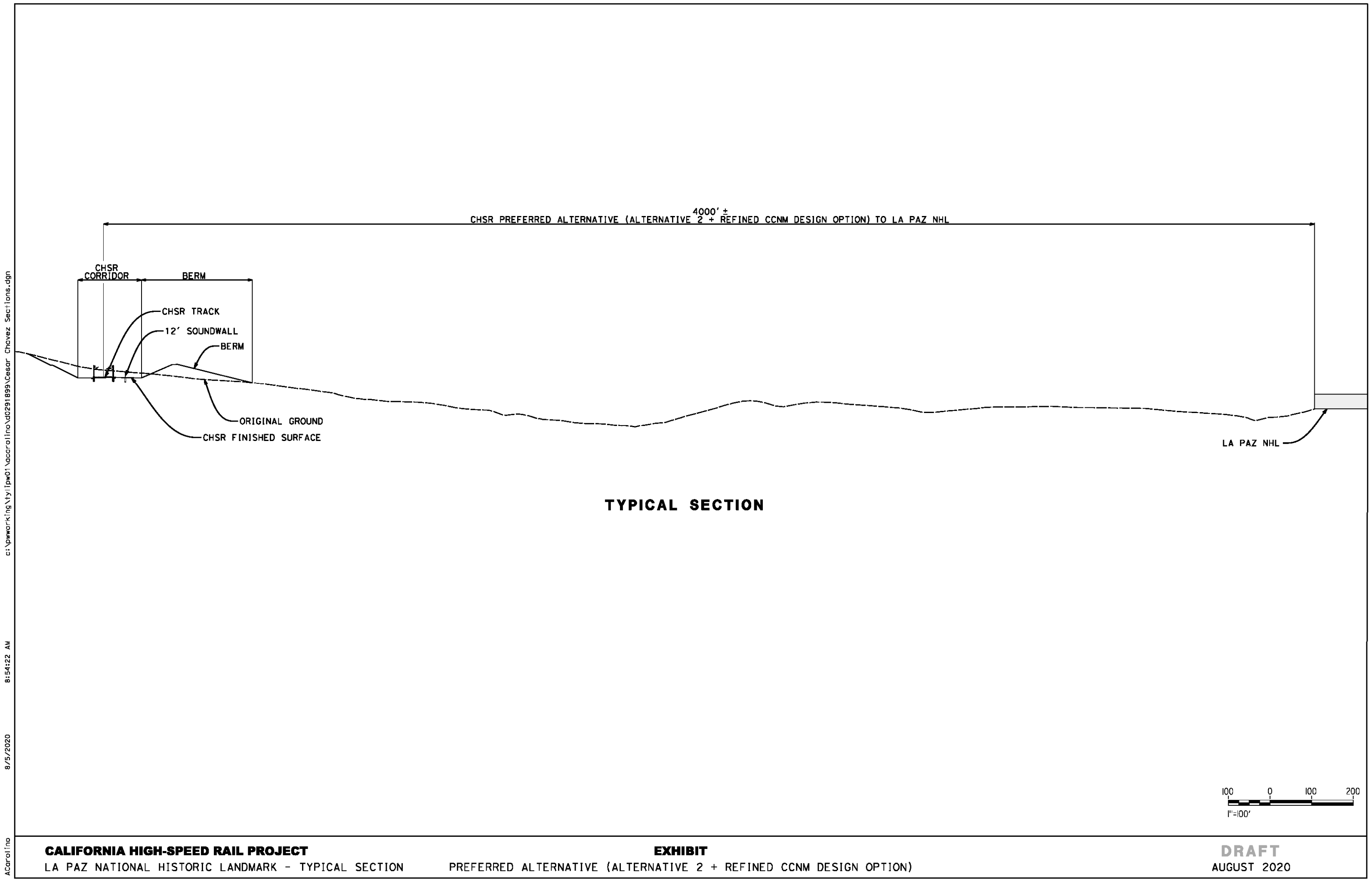
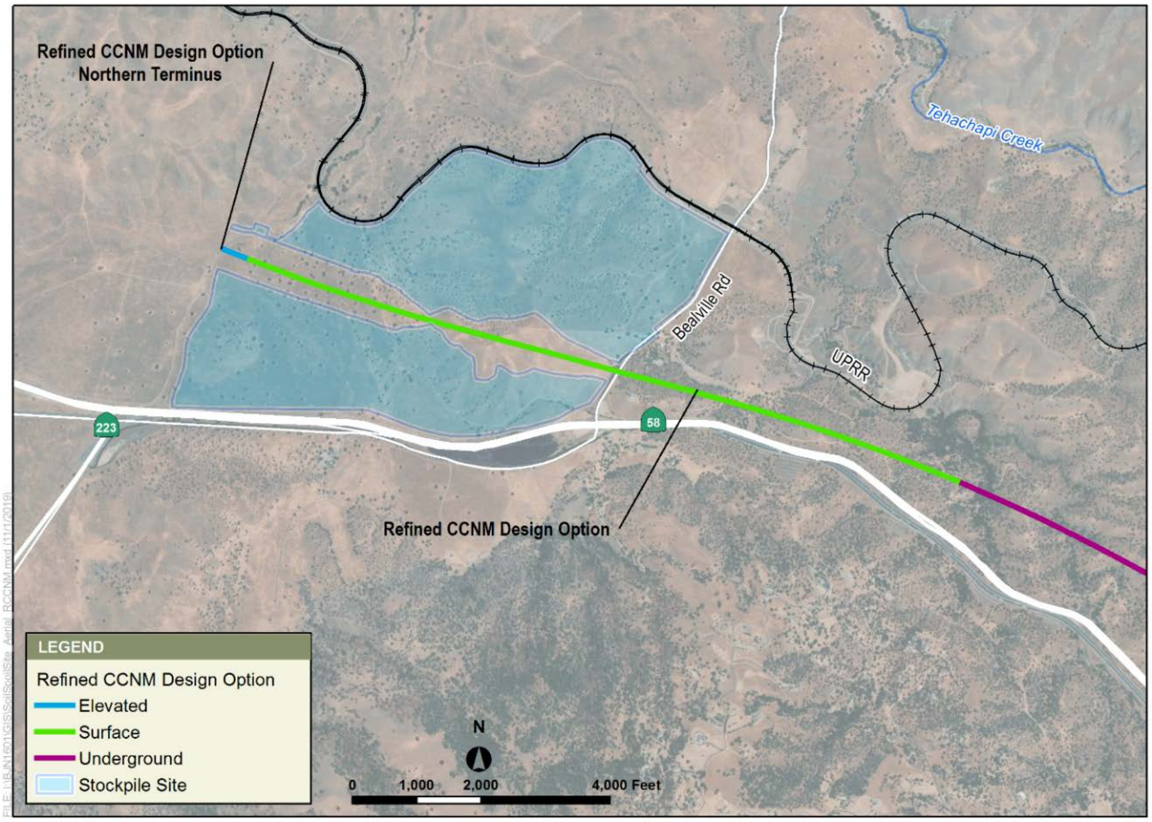


Figure 2-63 La Paz Cross Section



Source: California High-Speed Rail Authority, 2020

Figure 2-64 Refined CCNM Design Option On-Site Stockpile Site

2.4.2.7 Preferred Alternative/CEQA Proposed Project

At the October 16, 2018, Authority Board meeting, the Authority Board concurred with Authority staff that Alternative 2 with the César E. Chávez National Monument Design Option (CCNM Design Option) is the Authority's Preferred Alternative for the Bakersfield to Palmdale Project Section. Resolution #HSRA 18-18 can be found on the Authority's website (https://hsr.ca.gov/about/board/resolutions.aspx). At the same meeting, the Authority certified the Fresno to Bakersfield Section Final Supplemental EIR (Authority 2018a) and approved the F Street Station. Resolutions #HSRA 18-16 and #HSRA 18-17 can be found on the Authority's website.

Through ongoing Section 106 consultation for La Paz after the Authority Board's action on October 16, 2018, the Authority developed the Refined CCNM Design Option, which is also analyzed in this EIR/EIS. Because the Refined CCNM Design Option avoids adverse effects at La Paz, Alternative 2 with the Refined CCNM Design Option is the Authority's Preferred Alternative for the Bakersfield to Palmdale Project Section. This refinement to the Authority's Preferred Alternative is consistent with Resolution #HSRA 18-18, wherein the Authority Board directed Authority staff to "continue to consult and collaborate with the Cesar Chavez Foundation, and other consulting parties, regarding the CCNM Design Option."

The process for considering and the rationale for selecting the preferred alternative are presented in Chapter 8, Preferred Alternative and Station Site(s), of this EIR/EIS.

2.5 Travel Demand and Ridership Forecasts

Ridership forecasts were prepared to support ongoing planning for the HSR system and the analysis in this EIR/EIS. The forecasts were developed for the 2016 Business Plan by Cambridge Systematics, Inc., using a refined ridership and revenue model, *Business Plan Model Version 3*.

The ridership forecasts for the 2016 Business Plan were based on two distinct implementation scenarios: (1) a "Valley to Valley" implementation scenario, in which the Silicon Valley to Central Valley Line opens in 2025 and the Phase 1 HSR system opens in 2029, and (2) a "Valley to Valley extended" implementation scenario, in which the Silicon Valley to Central Valley Line opens with an extension to San Francisco and Bakersfield in 2025, and the Phase 1 HSR system opens in 2029. For each implementation scenario, the Business Plan presented "high," "medium," and "low" ridership forecasts, reflecting a range of probabilities.[13] Forecasts for each scenario were presented for a range of years from 2025 through 2060. Cambridge Systematics also prepared technical reports supporting the forecasts.

The ridership forecasts presented in this EIR/EIS are based on the "Valley to Valley" implementation scenario from the 2016 Business Plan. Both the "medium" and "high" ridership forecasts from the 2016 Business Plan are used in this EIR/EIS. In general, the medium ridership forecast provides for a conservative analysis of project benefits, whereas the high ridership forecast provides for a conservative analysis of adverse impacts.[14] For the year 2040, the 2016 Business Plan forecasts projected 42.8 million passengers under the medium ridership forecast, and 56.8 million passengers under the high ridership forecast.[15] (Table 2-17). The 2040 forecasts correspond to the horizon year used for impacts analysis in this EIR/EIS. Therefore, the EIR/EIS focuses on the 2040 forecasts.

Table 2-17 High-Speed Rail System Ridership Forecasts (in millions per year)

Forecasts	Silicon Valley to Central Valley Line (2025)	Phase 1 (2029)	Phase 1 (2040)
Medium	3.0	19.3	42.8
High	4.2	26.0	56.8

Source: California High-Speed Rail Authority, 2016d

The *Business Plan Model Version 3* refined the previous Version 2 model by fully integrating data gathered from the more recent stated preference and preference surveys. The model was further refined by incorporating a new variable that reduced the number of trips involving a relatively long trip to or from the HSR station combined with a relatively short trip on the HSR line itself. The variable reflected the disadvantages of those types of trips. In addition, several other small adjustments related to auto costs and transit networks were made to the model to produce updated forecasts.

A 5-year ramp-up assumption was made regarding when each section will open for revenue service. The assumption is based on the premise that only 40 percent of the forecast ridership would materialize in the first year, 55 percent in the second, 70 percent in the third, 85 percent in the fourth, and 100 percent in the fifth. This ramp-up applies only to the incremental ridership in Phase 1. The *California High-Speed Rail 2016 Business Plan Ridership and Revenue Forecasting: Technical Supporting Document* provides additional details regarding the modeling and forecasts (Authority 2016d).

[13] The development of the 2016 Business Plan forecasts included a probability assessment, which was generated though an analytical technique known as Monte Carlo simulations. The Monte Carlo analysis involves running thousands of simulations to assess the likelihood that a given outcome would occur.

[14] For additional detail regarding the use of "medium" and "high" ridership forecasts in this EIR/EIS, refer to Section 3.1, Introduction, in Chapter 3.

[15] See 2016 Business Plan, Exhibit 7.1 (Authority 2016f).

This range of ridership forecasts reflects the development of certain aspects of the HSR system's design and certain portions of the environmental analysis, as described in more detail below. Because the ultimate ridership of the HSR system will depend on many uncertain factors, such as the price of gasoline or population growth, the HSR system described in this document has been designed to accommodate the broad range of ridership expected over the coming decades.

Since the 2016 Business Plan forecasts were developed, the Authority has adopted its 2018 Business Plan, which was accompanied by updated forecasts. The 2016 and 2018 Business Plan ridership forecasts were developed using the same travel forecasting model; the forecasts differ due to changes in the model's inputs, including the high-speed rail service plan, demographic forecasts, estimates of automobile operating costs and travel times, and airfares. The medium ridership forecast for 2040 decreased by 6.5 percent, from 42.8 to 40 million, and the high ridership forecast decreased by 10.1 percent, from 56.8 to 51.6 million. In addition, the 2018 Business Plan assumes an opening year of 2033 rather than 2029 for the full Phase 1 system (Authority 2016d, *Business Plan: Ridership and Revenue Forecasting Technical Supporting Document*; and 2018b, *Business Plan: Technical Supporting Document: Ridership & Revenue Forecasting*).

The Authority released a Draft 2020 Business Plan on February 12, 2020, for public review and comment, which was extended for an additional 49 days due to the COVID-19 pandemic. The plan's final adoption was expected at the December 2020 Board meeting for submittal to the Legislature by December 15, 2020. However, in coordination with the Legislature, the deadline for adoption of a Final Business Plan was extended. A Revised Draft 2020 Business Plan was released for public review on February 9, 2021 and submitted to the Legislature by April 15, 2021 (Authority 2021).The 2020 Business Plan forecasts were developed using the same travel forecasting model as the 2016 and 2018 Business Plans, updated for population and employment forecasts. The Phase 1 medium ridership forecast for 2040 is 38.6 million, and the high is 50.0 million.

To the extent that the lower ridership levels projected in the 2018 Business Plan or the 2020 Business Plan would result in fewer trains operating in 2040, the impacts associated with the train operations in 2040 would be somewhat less than the impacts presented in this EIR/EIS and the benefits accruing to the project (e.g., reduced VMT, reduced greenhouse gas emissions, reduced energy consumption) also would be less than the benefits presented in this EIR/EIS. As with the impacts, the benefits would continue to build and accrue over time and would eventually reach the levels discussed in this EIR/EIS for the Phase 1 system.

2.5.1 Ridership and High-Speed Rail System Design

The HSR system analyzed in this EIR/EIS reflects the fact that the system is a long-term transportation investment for the State of California. It is being designed with state-of-the-art infrastructure and facilities that will serve passengers over many decades (Parsons Brinckerhoff 2010a). While the majority of the infrastructure components are being designed and built for full utility, certain components are more flexible and can change and adapt to meet ridership as it grows over time.

The Authority and the FRA weighed ridership and revenue potential in evaluating alignment and station alternatives in the Tier 1 Program EIR/EIS documents and the Tier 2 alternatives screening. However, the primary driver affecting the design of the HSR system is not the total forecasted annual ridership but rather the performance objectives and safety requirements stipulated by the Authority, the FRA, the U.S. Department of Transportation, and the regional transportation partners—including Caltrain, Amtrak and other operators—whose systems will either use the shared segments of the HSR alignment or provide connections to the high-speed service.

In keeping with these objectives and requirements, the portion of the alignment that is fully dedicated to HSR service comprises a two-track system for the majority of the right-of-way, with four tracks at intermediate stations regardless of total annual ridership. Track geometry and profile, power distribution systems, train control/signal systems, type of rolling stock, and certain station elements will be the same in both the dedicated and blended corridors regardless of how many riders use the HSR system. The location of the HMF and LMF structures also follows the mandates stipulated by technical operating requirements rather than ridership.

While the performance objectives and safety requirements are the main factors affecting HSR system design, ridership does influence some aspects of the system's design, including the size of the HMF and LMF structures (which are based on the 2040 high ridership forecast), to ensure that these facilities are large enough to accommodate maximum future needs. This approach is consistent with general planning and design practices for large infrastructure projects in which resilience and adaptability are achieved by acquiring enough land for future needs up front instead of trying to purchase property at a later date, when it may no longer be available or may be impractical to acquire. The use of ridership forecasts facilitates the early phases of maintenance facility construction as well as subsequent expansion of the facility as fleet size and maintenance requirements grow.

Forecasted annual ridership and peak-period ridership also play a role in determining the size of some station components, such as the size of the public accessway/egressway to the HSR system. The 2040 high ridership forecast formed the basis for the conceptual service plan, which in turn influenced station site planning by ensuring that station facilities would be sufficient to accommodate the anticipated increase over time of HSR use.

The 2040 high ridership forecast was also used, along with local conditions, to determine the maximum amount of parking needed at each station. Parking demand and supply were analyzed by considering many factors, including ridership demand, station area development opportunities, and availability of alternative multimodal access improvements, to inform the size of the parking facilities at each station and the anticipated schedule for the phased implementation of these facilities. The use of the 2040 high ridership forecast provides flexibility to change or even reduce the amount of station parking as these factors become more defined and resolved over time. (See Section 2.5.3 for additional information about parking in HSR station areas.)

2.5.2 Ridership and Environmental Impact Analysis

The forecasts of annual HSR ridership demand play a role in the analysis of environmental impacts and benefits related to traffic, air quality, noise, and energy. This EIR/EIS uses the medium and high ridership forecasts to analyze potential environmental impacts from operation of the HSR system. This is discussed in more detail in Section 3.1.

2.5.3 Ridership and Station-Area Parking

HSR system ridership, parking demand, parking supply, and development around HSR stations are intertwined and will evolve as annual ridership increases from the 3 million to 4.2 million anticipated at the start of revenue service in 2025 to as many as 56.8 million passengers in 2040, when the HSR system is in full operation. To attract, support, and retain high ridership levels, the Authority is working with transportation service providers and local agencies to promote transit-oriented development around HSR stations and expand multimodal access to the HSR system.

The implementation of these activities will vary at each station because some cities and regions will be able to develop their station areas and local transit systems at a faster rate than others by the 2025 start of HSR revenue service and before 2040, when the HSR system will be fully operational. In addition, technological advances, such as multimodal trip planning/payment software and autonomous vehicles, will affect parking demand and supply at each station, as will changes in the bundle of services available to consumers, such as ride-hailing services and bike- and car-sharing programs.

Research suggests that the percentage of transit passengers arriving/departing transit stations by car and needing parking accommodations decreases as land use development and population around the stations increase. The Authority has adopted station-area development policies that recognize the inverse relationship between parking demand and HSR station-area development. In keeping with these policies, the Authority is working with regional planners and planners in the station cities to maximize the success of the HSR system by locating stations in areas where there is, or will be, a high density of population, jobs, commercial development, entertainment venues, and other activities that generate trips. Encouraging development in high-density areas around HSR stations will allow the Authority to support system ridership while reducing parking demand.

However, land use development around HSR stations will not occur immediately. Although the HSR system will be a catalyst for development, local land use decisions and market conditions will dictate actual construction. The Authority will work in partnership with local governments to encourage station-area development, exemplified by the station-area planning funding agreements it has provided to the Cities of Fresno and Bakersfield, but the Authority's power in this regard is limited. As a result, the factors that will determine actual parking demand and supply depend primarily on local decisions and local conditions.

In light of the uncertainty regarding the need for station-area parking, this EIR/EIS conservatively identifies parking facilities based on the maximum forecast parking demand at each station and the local conditions affecting access planning. This approach results in providing the upper range of actual needs and the maximum potential environmental impacts of that range.

The Authority, in consultation with local communities, will have the flexibility to make decisions regarding which parking facilities will be built initially and how additional parking can be phased in or adjusted depending on how HSR system ridership increases over time. For example, some parking facilities could be built at the 2025 project opening and subsequently augmented or replaced in whole or in part based on future system ridership, station-area development, and parking management strategies. A multimodal access plan will be developed prior to the design and construction of parking facilities at each HSR station. These plans will be prepared in coordination with local agencies and will include a strategy that addresses and informs the final location, amount, and phasing of parking at each station.

2.6 Operations and Service Plan

2.6.1 High-Speed Rail Service

The conceptual HSR service plan for Phase 1 describes service from Anaheim and Los Angeles, through the Central Valley from Bakersfield to Merced, and northwest into the Bay Area (Appendix 2-C, Operations and Service Plan). Phase 2 of the HSR system include a southern extension from Los Angeles to San Diego via the Inland Empire and an extension from Merced north to Sacramento.

Three basic service types are planned for the HSR system:

- Express trains, which would serve major stations only and provide fast travel times (i.e., a run time between downtown San Francisco and LAUS of 2 hours and 40 minutes)
- Limited-stop trains, which would skip stations along a route to provide faster service between stations
- All-stop trains, which would focus on regional service

Table 2-18 lists the service types for Phase 1 of the HSR system.

The vast majority of trains would provide limited-stop services and offer a relatively fast run time along with connectivity among various intermediate stations. Numerous limited-stop patterns would be provided to achieve a balanced level of service at the intermediate stations. The service plan envisions at least four limited-stop trains per hour in each direction, all day long, on the main route between San Francisco and Los Angeles. Each intermediate station in the Bay Area, the Central Valley between Fresno and Bakersfield, Palmdale in the high desert, and Sylmar and Burbank in the San Fernando Valley would be served by at least two limited-stop trains every hour—offering at least two reasonably fast trains per hour to San Francisco and Los Angeles.

Selected limited-stop trains would be extended south of Los Angeles as appropriate to serve projected demand.

Table 2-18 High-Speed Rail Service Plan Assumptions for Phase 1

Northern Termini	Southern Termini	High-Speed Rail Service Summary	Conventional Rail Connections
San Francisco and Merced	Los Angeles and Anaheim	▪ Two peak TPH from San Francisco and Los Angeles (three in off-peak) ▪ Two peak TPH from San Francisco and Anaheim (one in off-peak) ▪ Two peak TPH from San Jose and Los Angeles (zero in off-peak) ▪ One peak TPH from Merced and Los Angeles (zero in off-peak) ▪ One peak TPH from Merced and Anaheim (same in off-peak)	▪ Coordinated service with Amtrak at Merced ▪ Metrolink connections at LAUS

Source: California High Speed Rail Authority, 2016d
LAUS = Los Angeles Union Station TPH = trains per hour

Including the limited-stop trains on the routes between Sacramento and Los Angeles and between Los Angeles and San Diego, and the frequent-stop local trains between San Francisco and Los Angeles and Anaheim and between Sacramento and San Diego, every station on the HSR network would be served by at least two trains per hour per direction throughout the day and at least three trains per hour during the morning and afternoon peak periods. Stations with higher ridership demand would generally be served by more trains than those with lower estimated ridership demand.

The service plan provides direct train service between most station pairs at least once per hour. Certain routes may not always be served directly, and some passengers would need to transfer from one train to another at an intermediate station, such as LAUS, to reach their final destination. Generally, the Phase 1 conceptual operations and service plan offers a wide spectrum of direct-service options and minimizes the need for passengers to transfer.

Total daily operations for the project section after full implementation of Phase 1 are summarized in Table 2-18.

The *California High-Speed Rail 2016 Business Plan: Ridership and Revenue Forecasting* (Authority 2016d) assumes that Phase 1 of the HSR system would open in stages, from 2025 through 2029. Upon completion, the Phase 1 HSR system would extend from a north terminal in San Francisco to the south terminal at Anaheim. The Bakersfield to Palmdale Project Section would connect the Central Valley to the Antelope Valley, closing the existing passenger rail gap over the Tehachapi Mountains with proposed stations in Bakersfield and at the Palmdale Transportation Center.

2.6.2 Maintenance Activities

The Authority would regularly perform maintenance along the track and railroad right-of-way, as well as on the power, train control, signalizing, communications, and other vital systems required for safe operation of the HSR system. FRA would specify standards of maintenance, inspection, and other items in a set of regulations (i.e., Rule of Particular Applicability) to be issued in the next several years. The brief descriptions of maintenance activities below are based on best professional judgment regarding future practices in California. Offsite drainages are to be maintained by the adjacent property owner that are outside of the right-of-way and not maintained by the Authority.

- **Track and Right-of-Way**—The track at any point would be inspected several times per week using measurement and recording equipment aboard special measuring trains. These trains are similar to the regular trains but operate at a lower speed. They would run between 12:00 a.m. and 5:00 a.m., and they would usually pass over any given section of track once per night.

  Most adjustments to the track and routine maintenance would be accomplished in a single night at any specific location, with crews and material brought by work trains along the line.

When rail resurfacing (i.e., rail grinding) is needed (perhaps several times per year), specialized equipment would pass over the track sections at 5 to 10 mph.

Approximately every 4 to 5 years, the ballasted track would require tamping. This more intensive maintenance of the track uses a train with a succession of specialized cars to raise, straighten, and tamp the track, and vibrating "arms" to move and position the ballast under the ties. The train would typically cover a 1-mile-long section of track in the course of one night's maintenance. Slab track, which is expected to comprise track at elevated sections, would not require this activity. No major track components are expected to require replacement through 2040.

Other maintenance of the right-of-way, aerial structures, and bridge sections of the alignment would include drain cleaning, vegetation control, litter removal, and other inspection that would typically occur monthly to several times per year.

- **Power**—The OCS along the right-of-way would be inspected nightly, with repairs being made when needed. Required repair would typically be accomplished during a one-night maintenance period. Other inspections would occur monthly. The status and many of the functions of substations and smaller facilities outside of the trackway would be monitored remotely. However, visits would be made to repair or replace minor items and would also be scheduled several times per month to check the general site. No major component replacements for the OCS or the substations are expected through 2040.
- **Structures**—Visual inspections of the structures along the right-of-way and testing of fire/life safety systems and equipment in or on structures would occur monthly; inspections of all structures for structural integrity would occur at least annually. Steel structures would also require painting every several years. Repair and replacement of lighting and communication components of tunnels and buildings would be performed on a routine basis. No major component replacements or reconstruction of any structures are expected through 2040.
- **Signaling, Train Control, and Communications**—Inspection and maintenance of signaling and train control components would be guided by FRA regulations and standards to be adopted by the Authority. Typically, physical in-field inspection and testing of the system would occur four times per year using hand-operated tools and equipment. Communication components would be inspected and maintained routinely. This would usually occur at night, although daytime work may be conducted if the work area is clear of the trackway. No major component replacement for these systems is expected through 2040.
- **HSR Stations**—Each station would be inspected and cleaned daily. Inspections of the structures, including the platforms, would occur annually. Inspections of other major systems, such as escalators, heating and ventilation, ticket-vending machines, and the closed-circuit television would be according to manufacturer recommendations. Major station components are not expected to require replacement through 2040.
- **Perimeter Fencing and Intrusion Protection:** Fencing and intrusion protection systems would be monitored remotely and inspected periodically. Maintenance would occur as needed; however, fencing or systems are not expected to require replacement before 2040.

2.7 Additional High-Speed Rail Development Considerations

2.7.1 High-Speed Rail, Land Use Patterns, and Development around High-Speed Rail Stations

In 2008, California voters approved Proposition 1A, essentially approving the California HSR System. Regarding urban development and land use patterns, voters specifically mandated that HSR stations "be located in areas with good access to local mass transit or other modes of transportation. The HSR system also shall be planned and constructed in a manner that minimizes urban sprawl and impacts on the natural environment," including "wildlife corridors."

In submitting Proposition 1A to the voters, the Legislature went further:

> "The continuing growth in California's population and the resulting increase in traffic congestion, air pollution, greenhouse gas emissions, and the continuation of urban sprawl make it imperative that the state proceed quickly to construct a state-of-the-art high-speed passenger train system to serve major metropolitan areas." (Assembly Bill No. 3034 [2008])

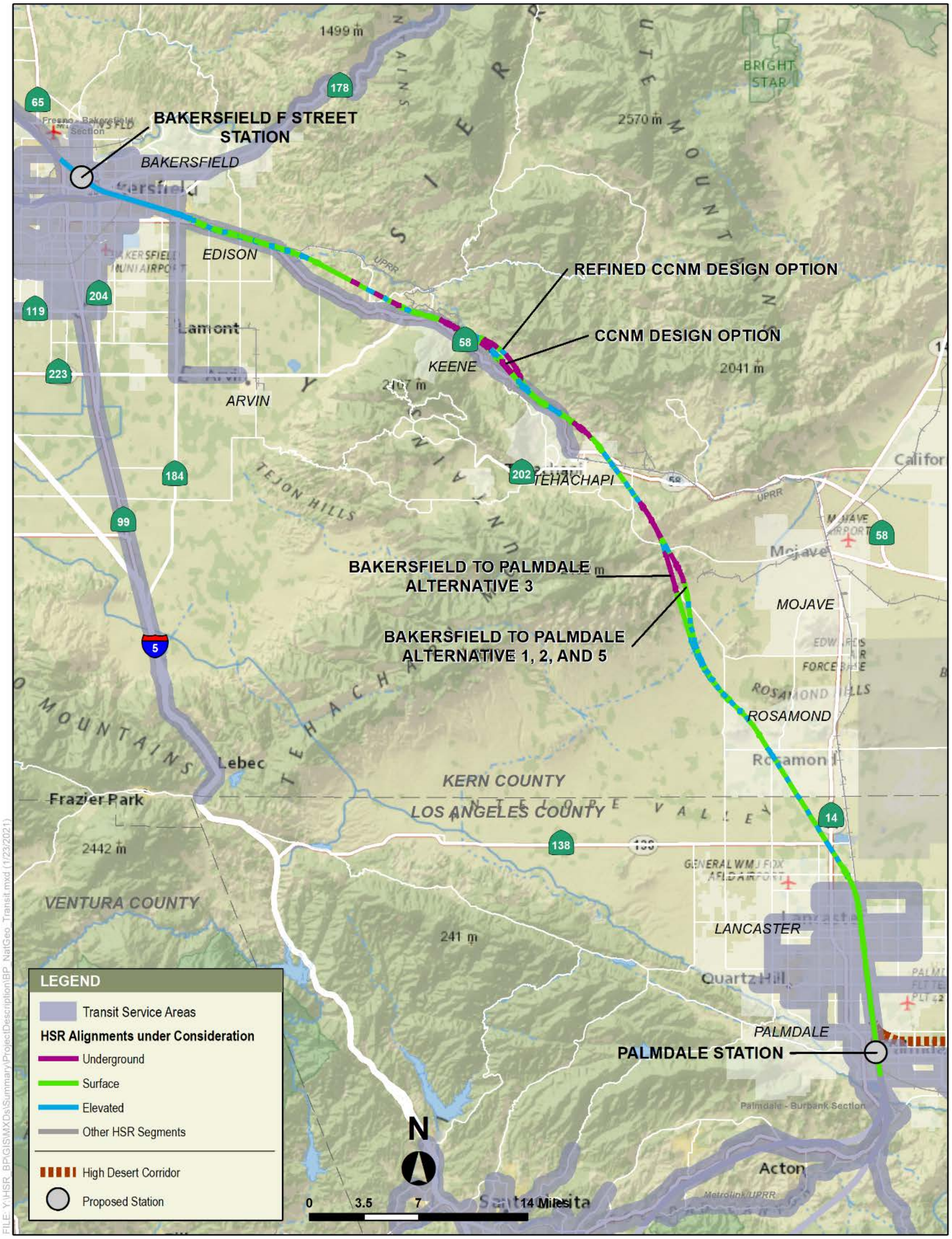
The Authority has embraced this voter and legislative direction. Figure 2-65 shows how the HSR system connects with existing transit service areas in the Bakersfield to Palmdale Project Section vicinity. As the Authority's Program EIR/EIS documents show and this EIR/EIS supports, operation of the HSR system by itself would reduce traffic congestion, air pollution, and greenhouse gas emissions. The Authority believes, however, that this is not enough. The HSR would be most successful, and would best fulfill the intent of the voters and Legislature, if it is coordinated with sprawl-reducing and environment-improving land use development patterns. Accordingly, the Authority has adopted *HST Station Area Development Policies* (Authority 2011a) based on the following premise:

> "For the high-speed train to be more useful and yield the most benefit, it is important that the stations be placed where there will be a high density of population, jobs, commercial activities, entertainment, and other activities that generate personal trips. The success of HST is highly dependent on land use patterns that also reduce urban sprawl, reduce conversion of farm land to development, reduce vehicle miles traveled (VMT) by automobiles, and encourage high-density development in and around the HST station" (Authority 2011a).

The Authority and its *HST Station Area Development Policies* specifically advocate:

- Higher-density development in relation to the existing pattern of development in the surrounding area, along with minimum requirements for density.
- A mix of land uses (e.g., retail, office, hotels, entertainment, and residential) and a mix of housing types to meet the needs of the local community.
- Compact pedestrian-oriented design that promotes walking, bicycle, and transit access with streetscapes that include landscaping, small parks, and pedestrian spaces.
- Limits on the amount of parking for new development and a preference that parking be placed in structures. Transit-oriented development areas typically have reduced parking requirements for retail, office, and residential uses due to their transit and bicycle access, walkability, and potential for shared parking. Sufficient train passenger parking would be essential to the HSR system's viability, but this would be offered at market rates (not free) to encourage the use of access by transit and other modes.
- Infill development (development around HSR stations on land that is already disturbed by existing development, parking lots, pavement, etc.) rather than development on previously undisturbed land or on farmland. The Authority prefers to locate its stations in existing developed areas, particularly city centers.

The Authority recognizes that land use development around HSR stations is controlled by local governments and the market, and that it is influenced by landowners and public-interest groups. The Authority also recognizes that local transit is controlled by regional and local transit agencies. The Authority is therefore committed to working cooperatively with local governments, transit agencies, public-interest groups, and the development community to realize a shared vision for land use and transit development around HSR stations, consistent with the Authority's development policies, to the maximum extent possible.



Source: California High-Speed Rail Authority, 2018

Figure 2-65 Bakersfield to Palmdale Transit Connectivity Map

Good land use planning helps ensure good land use development. Planning for infill development, however, is particularly complicated. Infill areas (e.g., established downtowns) typically consist of numerous small parcels with different property owners. Therefore, no single property owner exists to pay for the planning; government typically has to fund it. The 2008 economic downturn and the state's elimination of redevelopment agencies, however, have left local government resources particularly limited. Accordingly, the Authority has committed its resources, both financial and otherwise, to encourage good local government land use planning around HSR stations consistent with the above principles. The Authority believes implementation of its *HST Station Area Development Policies* and cooperative work with local governments (including funding for planning) would result in the types of environmental benefits voters and the Legislature contemplated in 2008. This EIR/EIS forecasts that the HSR project would reduce VMT and related greenhouse gas emissions, energy use, and traffic congestion, and improve air quality. To be conservative and consistent with CEQA and NEPA requirements, these forecasts generally do not account for the additional benefit expected from more compact development patterns—patterns that the Authority's *HST Station Area Development Policies* supports. The Authority began the "Vision California" study effort, with funds provided by the California Strategic Growth Council and the Authority, to help account for these additional sustainability benefits that would exceed the benefits reported in this EIR/EIS.

Vision California was a first-of-its-kind effort to explore the role of land use and transportation investments in meeting the environmental, fiscal, and public-health challenges facing California over the coming decades. The project produced new scenario development and analysis tools to examine the impacts of varying policy decisions and development patterns associated with accommodating the expected dramatic increase in California's population by 2050. Vision California's tools quantitatively illustrate the connections among land use patterns, water and energy use, housing affordability, public health, air quality, greenhouse gas emissions, farmland preservation, infrastructure investment, and economic development. The tools allow state agencies, regions, local governments, and the nonprofit community to measure the impacts of land use and transportation investment scenarios. More information about the Vision California project and the final Vision California Report can be found at www.calthorpe.com/vision-california.

Vision California involves two different models developed by Calthorpe Associates. An open-source geospatial model called UrbanFootprint is map-based and analyzes detailed base and scenario data at the 5.5-acre level across most parts of the state. The model is scalable to conduct analyses of local and regional land use and guide infrastructure decisions. The Sacramento Area Council of Governments, South Coast Association of Governments, and San Diego Association of Governments use Version 1 of the UrbanFootprint model for updating their RTPs and preparing Sustainable Communities Strategies. Another modeling tool, called "Rapid Fire,"[16] has been deployed statewide and in regions across California. Two Vision California statewide growth scenarios—"Business as Usual" and "Growing Smarter"—were developed and analyzed in the Vision California process using Rapid Fire. Business as Usual assumes continuation of the past trend of less compact development patterns. Growing Smarter assumes an increasing proportion of urban infill and compact growth.

The Growing Smarter scenario is closely linked to implementation of the HSR system and supportive feeder transit services. This relationship is particularly true in regions of the state that currently lack high-quality transit facilities, such as the San Joaquin Valley, where realization of the level of urban and compact growth envisioned in the Growing Smarter scenario would not occur without the significant investment and mobility enhancements represented by the California HSR System.

[16] Rapid Fire was developed by Calthorpe Associates to produce and evaluate statewide, regional, and county-level scenarios across a range of metrics. Results are calculated using empirical data and the latest research on the role of land use and transportation systems on automobile travel; emissions; public health; infrastructure cost; city revenues; and land, energy, and water consumption. The model constitutes a single framework into which these research-based assumptions can be loaded to test the impacts of varying land use patterns (Calthorpe Associates 2011).

Rapid Fire predicts that by 2050, implementation of the more compact growth of the Growing Smarter scenario would (Calthorpe 2011):

- Save over $7,300 per household annually on automobile costs and utility bills
- Save $1.1 billion per year from lower infrastructure costs for new homes
- Save 18 million acre-feet of water by 2050—enough water to fill Hetch Hetchy Reservoir 50 times
- Cut residential and commercial building energy use by 15 percent—enough to power all homes in California for 8 years
- Save over 3,700 square miles of land by 2050—more than the area of Rhode Island and Delaware combined
- Reduce fuel consumption through 2050 equivalent to 2 years of U.S. oil imports, which amounts to a savings of $2,600 per year per household
- Reduce greenhouse gas emissions equivalent to the emissions offset by a forest one-quarter the size of California
- Reduce pollution-related respiratory disease, saving more than $1.6 billion annually
- Reduce passenger vehicle travel by more than 4 trillion miles, the equivalent of taking all cars off California's roads for 15 years

Construction of the California HSR System, coupled with successful implementation of the Authority's Station Area Development Policies, would reinforce cities as hubs of economy and future growth and would save land and water, reduce energy use, improve air quality, and save money. The initial findings of the Vision California study suggest that these benefits could be substantial and would help California meet its sustainability goals.

2.7.2 Right-of-Way Acquisition for Construction, Operation, and Maintenance of the High-Speed Rail System

Construction and operation of the Bakersfield to Palmdale Project Section would result in temporary and permanent acquisitions of existing and planned land uses. Table 2-19 and Table 2-20 show the acreage of land that would be subject to temporary conversion by existing land use type and planned land use type for the B-P Build Alternatives, the Lancaster North B MOWF site, the Avenue M LMF/MOWF site, and the Palmdale Station area. Table 2-21 and Table 2-22 provide the total acres of existing land uses and planned land uses estimated to be permanently affected by the B-P Build Alternatives, the Lancaster North B MOWF the Avenue M LMF/MOWF site, and the Palmdale Station. These permanent impacts are defined as land that would be used permanently for HSR tracks and supporting facilities (e.g., traction power and communication systems). The acreages identified in the tables include land affected by both full- and partial-parcel acquisitions within the permanent footprint. Agricultural land uses represent the majority of the existing and planned land uses estimated to be converted permanently by each of the four B-P Build Alternatives. For additional detail on temporary and permanent acquisitions, see Section 3.13, Station Planning, Land Use, and Development.

Table 2-19 Temporary Conversion of Existing Land Uses

Alternative	Acres of Existing Land Uses Subject to Temporary Conversion[1,]										
	Agriculture	Commercial	Public	Industrial	Institutional	Railroads/ Utilities	Natural Resources	Recreational	Residential	Vacant Land	Total
Alternative 1	896	17	18	88	1	59	20	1	26	546	**1,672**
Alternative 2	870	13	15	88	1	59	20	1	25	545	**1,637**
Alternative 3	886	17	20	80	1	65	9	1	28	537	**1,644**
Alternative 5	896	20	17	93	1	58	20	1	30	558	**1,694**
CCNM Design Option[3]	+15	–	–	–	–	–	–	–	–	–	**+15**
Refined CCNM Design Option [3]	-98	–	-1	–	–	–	–	–	-1	35	**-65**
Lancaster North B MOWF	–	–	–	–	–	–	–	–	–	–	–
Avenue M LMF/MOWF Site	–	–	–	–	–	–	–	–	–	–	–
Palmdale Station[2]	–	–	–	–	–	–	–	–	–	–	–

Source: California High-Speed Rail Authority, 2019b
[1] Values are rounded to the nearest whole number; therefore, the grand totals are rounded as well.
[2] All construction and staging activities for the Palmdale Station would occur within the permanent footprint. Therefore, any land in the Palmdale Station area that would be temporarily used to construct the project would ultimately be the site of permanent project-related improvements (e.g., parking lots, drainage basins).
[3] Values are +/- relative to Alts 1, 2, 3, and 5
– = no change LMF = light maintenance facility MOWF = maintenance-of-way facility

Table 2-20 Temporary Conversion of Planned Land Uses

Alternative	Acres of General Plan Designated Land Uses Subject to Temporary Conversion[1]									
	Agriculture	Commercial	Industrial	Mixed Use[2]	Natural Resources	Public	Residential[3]	Transportation/ Utilities	Miscellaneous[4]	Total
Alternative 1	1,034	39	149	8	257	12	205	33	58	**1,795**
Alternative 2	1,040	39	133	8	253	11	205	37	58	**1,784**
Alternative 3	1,017	39	150	8	242	16	205	33	58	**1,768**
Alternative 5	1,034	54	149	7	259	12	214	33	58	**1,820**
CCNM Design Option[6]	+12	–	–	–	+3	–	–	–	–	**+15**
Refined CCNM Design Option[6]	-58	–	2	–	-21	–	-2	-2	–	**-81**
Lancaster North B MOWF	–	–	–	–	–	–	–	–	–	–
Avenue M LMF/MOWF Site	–	–	–	–	–	–	–	–	–	–
Palmdale Station[5]	–	–	–	–	–	–	–	–	–	**–**

Source: California High-Speed Rail Authority, 2019b
[1] Values are rounded to the nearest whole number; therefore, the grand totals are rounded as well.
[2] Includes the Specific Plan category in the City of Palmdale General Plan (1993).
[3] Includes single-family and multifamily residential uses.
[4] Includes the Incorporated Cities, Natural, Neighborhood Edge, Neighborhood Central, Neighborhood General, Rural General, Special District 1, and Special District 3 categories in the City of Tehachapi General Plan (2012).
[5] All construction and staging activities for the Palmdale Station would occur within the permanent footprint. Therefore, any land in the Palmdale Station area that would be temporarily used to construct the project would ultimately be the site of permanent project-related improvements (e.g., parking lots, drainage basins).
[6] Values are +/- relative to Alts 1, 2, 3, and 5
–- = no change LMF = light maintenance facility MOWF = maintenance-of-way facility

Table 2-21 Permanent Conversion of Existing Land Uses

Alternative	Acres of Existing Land Uses Subject to Permanent Conversion[1,2]										
	Agriculture	Commercial	Public	Industrial	Institutional	Railroads/ Utilities	Natural Resources	Recreational	Residential[3]	Vacant Land	Total
Alternative 1	2,626	125	86	429	5	542	52	4	87	1,860	**5,816**
Alternative 2	2,674	124	86	421	5	342	56	4	87	1,859	**5,658**
Alternative 3	2,778	125	97	405	5	344	36	4	96	1,780	**5,670**
Alternative 5	2,626	130	81	411	6	288	52	3	91	1,822	**5,510**
CCNM Design Option[4]	-12	–	–	–	–	–	–	–	–	–	**-12**
Refined CCNM Design Option[4]	658	-1	–	–	–	–	–	–	1	–	**+658**
Lancaster North B MOWF	–	–	–	–	–	–	–	–	3	130	**133**
Avenue M LMF/MOWF Site	–	9	–	8	–	–	–	–	–	156	**173**
Palmdale Station Site	–	32	2	44	1	68	–	7	32	343	**529** [4]

Source: California High-Speed Rail Authority, 2019b
[1] Values are rounded to the nearest whole number; therefore, the grand totals are rounded as well.
[2] Acreage includes land affected by both full- and partial-parcel acquisitions within the permanent footprint.
[3] Includes single-family and multifamily residential uses.
[4] Values are +/- relative to Alts 1, 2, 3, and 5
– = no change LMF = light maintenance facility MOWF = maintenance-of-way facility

Table 2-22 Permanent Conversion of Planned Land Uses

Alternative	Acres of General Plan Designated Land Uses Subject to Permanent Conversion[1,2]									
	Agriculture	Commercial	Industrial	Mixed Use[3]	Natural Resources	Public	Residential[4]	Transportation/ Utilities	Miscellaneous[5]	Total
Alternative 1	2,853	346	699	262	908	35	639	96	273	**6,111**
Alternative 2	2,810	346	713	262	914	35	633	69	273	**6,055**
Alternative 3	2,830	346	699	262	959	53	640	96	279	**6,164**
Alternative 5	2,853	385	584	224	914	35	640	95	368	**6,098**
CCNM Design Option[6]	+11	–	–	–	-23	–	–	–	–	**-12**
Refined CCNM Design Option[6]	732	–	4	-1	36		1	12	–	**+784**
Lancaster North B MOWF	–	–	–	–	–	–	134	–	–	**134**
Avenue M LMF/MOWF Site	–	153	20	–	–	–	–	–	–	**173**
Palmdale Station Site	–	161	184	41	–	29	113	1	–	**529**

Source: California High-Speed Rail Authority, 2019b
[1] Values are rounded to the nearest whole number; therefore, the grand totals are rounded as well.
[2] Acreage includes land affected by both full- and partial-parcel acquisitions within the permanent footprint.
[3] Includes the Specific Plan category in the City of Palmdale General Plan (1993).
[4] Includes single-family and multifamily residential uses.
[5] Includes the Incorporated Cities, Natural, Neighborhood Edge, Neighborhood General, Rural General, and Special District 1 categories in the City of Tehachapi General Plan (2012).
[6] Values are +/- relative to Alts 1, 2, 3, and 5
– = no change LMF = light maintenance facility MOWF = maintenance-of-way facility

The Authority has developed a right-of-way process that is in accordance with the Uniform Relocation Assistance and Real Property Acquisition Policies Act. Figure 2-66 shows the right-of-way process, which has four major milestones: design/survey, appraisal, acquisition, and relocation.

The Authority has developed a permission-to-enter process for private property owners to be utilized for (1) environmental phase fieldwork and (2) ongoing (post-EIR/EIS), pre-construction fieldwork. The permission-to-enter process for the environmental phase fieldwork covers environmental studies and geotechnical field investigation work, and the ongoing (post-EIR/EIS), pre-construction fieldwork covers ongoing environmental studies and geotechnical field investigations.

For large organizations with their own permission-to-enter processes (utilities, railroads, water districts, school districts, etc.), general permission-to-enter letters are not sent but are handled on a case-by-case basis (Authority 2014d).

The displacement of a small percentage of the population is often necessary in the building of any large, modern transportation project. However, Authority policy requires that displaced persons shall not suffer unnecessarily as a result of a program like the HSR project that is designed to benefit the public as a whole. Individuals, families, businesses, farms, and nonprofit organizations displaced by the project may be eligible for relocation advisory services and payments. More details on relocation assistance for residences (Authority 2013d); mobile homes (Authority 2013c); and businesses, farms, and nonprofit organizations (Authority 2013b) are provided in the Authority's *Your Rights and Benefits as a Displacee Under the Uniform Relocation Assistance Program* brochures.

2.8 Construction Plan and Phased Implementation Strategy

This section summarizes the general approach to building the HSR system, including activities associated with pre-construction and construction of major system components. It also describes the Authority's phased implementation strategy. The Authority started final design in fall 2013 and initiated project construction in 2014 (Authority 2015). Construction in the Central Valley is under way and will be completed by 2024. Service on the Silicon Valley to Central Valley line is expected to start in 2025.

2.8.1 Design-Build Project Delivery

The Bakersfield to Palmdale Project Section would be built using a "design-build" (DB) approach. This method of project delivery involves a single contract with the project owner to provide design and construction services. This differs from the "design-bid-build" approach, where design and construction services are managed under separate contracts and the design is completed before the project is put out for construction bids. The DB approach offers more flexibility to adapt the project to changing conditions. The contract with the DB contractor would require compliance with standard engineering design and environmental practices and regulations, as well as implementation of any project design features and applicable mitigation measures included in this EIR/EIS.

The Authority plans to construct the Bakersfield to Palmdale Project Section as part of Phase 1 of the California HSR Project, which would connect the Bay Area to Los Angeles/Anaheim. The Bakersfield to Palmdale Project Section would connect the Central Valley to the Antelope Valley, closing the existing passenger rail gap over the Tehachapi Mountains (Authority 2016e).

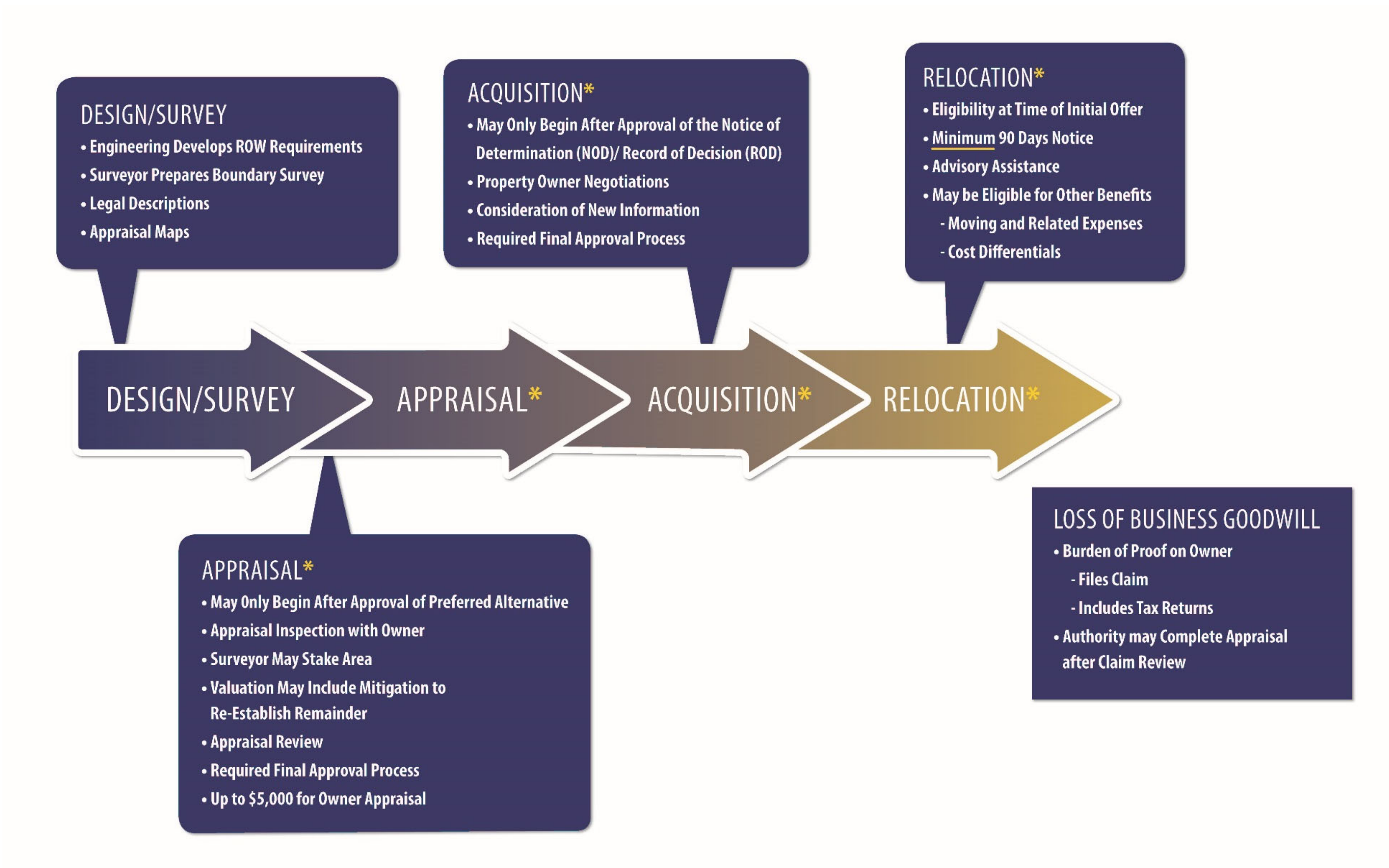


Figure 2-66 Right-of-Way Process

2.8.2 Phased Implementation Strategy

The Authority has prioritized a portion of the Merced to Fresno and Fresno to Bakersfield project sections as the first section of the California HSR System to be built for a number of reasons, including meeting the American Recovery and Reinvestment Act funding requirements, which include a funding deadline of September 30, 2017. In addition, the FRA grant agreement includes the requirement that the federal investment demonstrate “independent utility” as that term is defined in the *High Speed Intercity Passenger Rail Notice of Funding Availability and Interim Program Guidance* (74 Fed. Reg. 29900, 29905). Full implementation of HSR service on the Initial Operating Segment would satisfy this “independent utility” requirement, but so would earlier phases of rail service on the Initial Construction Segment. For example, the Initial Construction Segment presents an opportunity for immediate use for improved and faster service on the San Joaquin intercity line prior to the initiation of HSR service on the Initial Operating Segment in 2022, thus providing for independent utility consistent with the FRA grant agreement.

As described in Chapter 1, the Authority has developed a phased implementation strategy to deliver the HSR system, with a priority on completing Phase 1 of the HSR system between San Francisco and Anaheim while also continuing planning for Phase 2 project sections.

As reinforced in the Authority’s business plans, the first passenger service would operate between the Central Valley and the Silicon Valley, then extend to completion of Phase 1.

2.8.3 General Approach

Upon receiving the required environmental approvals and securing needed funding, the Authority would begin implementing its construction plan. Given the size and complexity of the HSR project, the design and construction work could be divided into a number of procurement packages. In general, the procurement would address the following:

- Civil/structural infrastructure, including design and construction of passenger stations, maintenance facilities, and right-of-way facilities
- Trackwork, including design and construction of direct-fixation track and sub-ballast, ballast, ties and rail installation, switches, and special trackwork
- Core systems, such as traction power, train controls, communications, the operations center, and the procurement of rolling stock

One or more DB packages would be developed, and the Authority would then issue construction requests for proposals, start right-of-way acquisition, and procure construction management services to oversee physical construction of the project. During peak construction periods, work is envisioned to be under way at several locations along the route, with overlapping construction of various project elements. Working hours and workers present at any time would vary depending on the activities being performed. Where construction fencing is required, it would be restricted to areas designated for construction staging and areas where public safety is an issue. Although the DB contractor would set the actual schedule, the approximate schedule for construction would be approximately 8 years. A breakdown of estimated durations of activity is provided in Table 2-23.

Consistent with the *Memorandum of Understanding for Achieving an Environmentally Sustainable High-Speed Train System in California* (Authority 2011f), the Authority intends to build the project using sustainable methods that:

- Minimize use of nonrenewable resources.
- Minimize impacts on the natural environment.
- Protect environmental diversity.
- Protect, maintain, conserve, and restore wildlife corridors and habitat.
- Emphasize using renewable resources in a sustainable manner. An example of this approach is use of material recycling for project construction (e.g., asphalt, concrete, Portland Cement Concrete, or excavated soil).

Table 2-23 Construction Schedule

Activity	Tasks	Duration[1]
Right-of-Way Acquisition	▪ Proceed with right-of-way acquisitions after the Authority approves a Record of Decision and once the state Legislature appropriates funds in the annual budget	As quickly as possible, estimated to be completed 2 years after the Record of Decision
Survey and Pre-Construction	▪ Locate utilities ▪ Establish right-of-way and project control points and centerlines ▪ Establish or relocate survey monuments ▪ Conduct geotechnical investigations	2 years
Mobilization	▪ Safety devices ▪ Special construction equipment	6 months at each construction staging location
Site Preparation	▪ Utility and roadway relocation ▪ Clearing/grubbing right-of-way ▪ Establishment of detours and haul routes ▪ Preparation of construction equipment yards, stockpile materials, and pre-cast concrete segment casting yard	2 to 3 years overall; within 6 months at each construction staging location
Earthmoving	▪ Excavation and earth support structures	4 years; highly dependent on chosen staging and sequencing
Tunneling	▪ Construct tunnels at planned locations	3 to 5 years; dependent on selected technology and geotechnical findings
Construction of Road Crossings	▪ Surface street modifications ▪ Grade separations	4 to 5 years; dependent on alternative chosen and number of grade separations to be built
Construction of Elevated Structures	▪ Aerial structure and bridge foundations, substructure, and superstructure	3.5 to 5 years
Track Laying	▪ Includes backfilling operations and drainage facilities	2 years
Systems	▪ Train control systems ▪ Overhead contact system ▪ Communication system ▪ Signaling equipment	2 years
Demobilization	▪ Includes site cleanup	1 year
Maintenance Facilities	▪ Construction of facilities along the alignment	2 years

Source: California High-Speed Rail Authority, 2016a
FRA = Federal Railroad Administration
[1] the durations of some of the listed activities may overlap

Fill material would be excavated from project construction activities within the Bakersfield to Palmdale Project Section. Railroad ballast would be drawn from existing, permitted quarries with sufficient supply quantities located closest to the construction areas from the Bay Area to Southern California, including those in the southern San Joaquin Valley and Mojave Desert. Ballast would be delivered by a combination of rail and trucks. All materials would be suitable for construction purposes and free from toxic pollutants in toxic amounts in accordance with Section 307 of the Clean Water Act, and state and local requirements, as applicable. Construction water sources would be from municipal providers in Bakersfield or Lancaster, and water would be hauled by truck from these municipal sources for construction in the Tehachapi area.

Applicable design standards, including compliance with laws, regulations, and industry standard practices, are provided in Appendix 2-D and are considered part of the project.

2.8.4 Pre-Construction Activities

2.8.4.1 Operational Right-of-Way

During final design, the Authority and its contractor would conduct a number of pre-construction activities to determine how to best stage and manage actual construction. These activities include the following:

- Conducting geotechnical investigations that would focus on defining geology, groundwater, seismic, and environmental conditions along the alignment. The results of this work would guide final design and construction methods for foundations, underground structures, tunnels, stations, grade crossings, aerial structures, systems, and substations.

  Helicopters may be utilized to access geotechnical field investigation sites. Geotechnical field investigations would be conducted during the 30 percent preliminary design phase. The environmental effects of these activities are considered and evaluated in this EIR/EIS. Geotechnical field investigation activities include the following:

  - Performing site grading to provide drill rig access and a working area for the drill rig where required.
  - Excavating and recovering soil and rock samples from borings and rock cores and performing cone penetration testing at the locations and to target depths varying from 50 feet to 835 feet. Whenever possible, boring sites would be located on existing roads and within public rights-of-way.
  - Installing piezometers and performing groundwater sampling where groundwater is encountered.
  - Performing fault trenching and trench logging. Locations would be chosen following geophysical surveys. It is anticipated that trenching would be able to be performed at the Edison, White Wolf, and Garlock faults. Trenching at the Tehachapi Creek fault is dependent on geophysical and mapping results.
  - Temporary storage of soil and rock samples in the City of Tehachapi or the City of Palmdale for 24 months.

  An engineer or geologist would supervise the boring explorations and piezometer installations, observe and classify soil samples, and prepare logs of borings. Upon completion, the borings would be backfilled with soil from the excavation in accordance with permit requirements. Environmental testing would be done on drill spoils collected in 55-gallon drums for transport and disposal to a certified disposal site. Work locations would be secured with fencing or surveillance, and temporary traffic-control devices would be installed as needed. Appropriate permits would be obtained from the affected local jurisdiction, and all activities would be conducted in accordance with those permits.

- Identifying construction laydown and staging areas used for geotechnical investigations, mobilizing personnel, stockpiling materials, and storing equipment for building HSR or related improvements. In some cases, these areas would also be used to assemble or pre-fabricate components of guideway or wayside facilities before transport to installation locations. The Authority and its contractor would also identify pre-casting yards, which would be needed for the casting, storage, and preparation of pre-cast concrete segments, temporary spoil storage, workshops, and temporary storage of delivered construction materials. Field offices and temporary jobsite trailers would also be located at the staging areas. Construction laydown areas are part of the project footprint evaluated for potential environmental impacts, but actual use of the area would be left to the discretion of the DB contractor. After conclusion of construction and geotechnical investigations, the staging, laydown, and pre-casting areas would be restored to pre-construction conditions.

- Initiating site preparation and demolition, such as clearing, grubbing, and grading, followed by the mobilization of equipment and materials. Demolition would require strict controls to ensure that adjacent buildings or infrastructure are not damaged or otherwise affected by the demolition efforts.
- Relocating utilities. The contractor would work with the utility companies to relocate or protect in place high-risk utilities such as overhead tension wires, pressurized transmission mains, oil lines, fiber-optics, and communications prior to construction and geotechnical investigations.
- Implementing temporary, long-term, and permanent road closures to reroute or detour traffic away from construction activities. Handrails, fences, and walkways would be provided for the safety of pedestrians and bicyclists.
- Constructing the access and haul routes. This activity would require clearing and grubbing, potential demolition and relocation of utilities, establishment of detours, erection of safety devices, and earthmoving activities. Haul routes would use existing roads as much as possible. The project would require inbound and outbound and off-road and on-road earth haul routes for movement of excavated materials, import of fill, and transport of concrete to the jobsite, as well as spoils, debris disposal, and hazardous waste materials removal. Large amounts of material would be moved in order to construct the access and haul routes.
- Locating temporary batch plants as needed to produce Portland cement concrete or asphaltic concrete needed for roads, bridges, aerial structures, retaining walls, and other large structures. The facilities generally consist of silos containing fly ash, lime, and cement; heated tanks of liquid asphalt; sand and gravel material storage areas; mixing equipment; aboveground storage tanks; and designated areas for sand and gravel truck unloading, concrete truck loading, and concrete truck washout. The contractor would be responsible for implementing procedures for reducing air pollutant emissions, mitigating noise impacts, and reducing the discharge of potential pollutants from the use of equipment, materials, and waste products into storage drains or watercourses.
- Conducting other studies and investigations as needed, such as local business or agriculture surveys to identify usage, delivery, shipping patterns, and critical times of the day or year for business, planting, or harvesting activities. This information would help develop construction requirements and worksite traffic control plans, and it would identify potential alternative routes, cultural resource investigations, and historic property surveys.
- Constructing access roads to connect the HSR right-of-way with existing local roads. The contractor would be responsible for roads within the right-of-way to extend access to tunnel portals and on-site construction staging sites. The contractor would maintain these on-site temporary roads and relocate them as general project grading develops.

  The contractor must sequence the tunnel/bridge construction with the mass grading to provide access to these sites, which are currently located in remote areas. Grading would begin with bulldozers and other appropriate equipment for pioneering roads as needed to initialize the mass-grading operations. The contractor would construct haul roads suitable for dump trucks as part of the mass-grading operations along the alignment. Additionally, the contractor would construct and maintain access roads suitable for highway-legal vehicles within the grading limits as needed to reach staging sites for tunnel and viaduct construction. Construction of tunnels and extended viaduct structures would require specialized heavy equipment to accomplish the work. Access roads to reach tunnel portals and bridge locations must be suitable for highway-legal trucks and trailers (“18-wheelers”) to deliver equipment and materials.

2.8.4.2 Non-Operational Right-of-Way

In certain negotiated right-of-way purchase situations, the Authority may enter into agreements to acquire properties or portions of properties that are not directly needed for the construction of the HSR Project and are not intended to be part of the operational right-of-way. These are known as excess properties, and are distinct from severed remnant parcels (which are evaluated as part of the project footprint). Although eventually these properties would likely be sold as excess state property, these excess properties are not part of the project footprint and in the interim the Authority would need to conduct various management and maintenance activities on them (Authority 2018b).

The process for acquisition and disposal of excess property is detailed in Chapter 16 of the *California High-Speed Rail Authority Right of Way Manual* (Authority 2019d). Chapter 11 of the *California High-Speed Rail Authority Right of Way Manual* identifies the following management and maintenance activities that may take place on any given excess property. The activities required on a given parcel will depend on site conditions, including the presence of buildings or other structures, existing land uses, and habitat conditions.

- **Structure Demolition**—Various structures may be present on excess property, including single and multifamily residences, mobile homes, mobile offices, warehouses and other light industrial structures, sheds, fences, concrete driveways, signs, other non-descript buildings, and related appurtenances and utilities (e.g. in-ground pools, septic systems, water wells, gas lines) as well as orchards and ornamental shrubs and trees.

  If the Authority determines that any existing uses of a particular structure are not going to continue, it may, following additional environmental review if/as necessary (for example, to confirm the structure is not considered historic), decide to demolish and remove the structure. Demolition of a structure may also be appropriate if the structure is in a state of disrepair or a potential safety and security concern exists from trespassers.

  The properties may include utilities such as water wells, septic systems, gas, and electric lines that would require removal in accordance with local and state regulations. Local construction permits for demolition and removal would be secured from the local agency with jurisdiction (e.g. well demo permit, septic removal).

- **Vegetation Management**—Excess properties may have a variety of vegetation present including ornamental landscaping, various crops including orchards or vineyards, and natural habitats such as annual grassland. Vegetation management may occur as part of initial site clearing efforts or as part of ongoing management.

  Initial site clearing is likely to occur in conjunction with structure demolition. Ornamental landscaping may be removed to reduce ongoing maintenance needs. Vegetation removal or disturbance may be necessary for equipment access during structure demolition. If certain agricultural crops are present on site, particularly orchards or vineyards, they may be removed if the Authority determines that it is appropriate, based on the condition of the plants.

  Ongoing vegetation management activities may include mowing, discing, or similar mechanical control, the clearing of firebreaks on larger properties, and, if noxious weeds are present, they may be treated with the use of approved herbicides. Mowing or other mechanical control may be used to maintain vegetation at a certain height or density based on site specific concerns of security, visual appearance or fire prevention. The mechanical control of weed species may also be appropriate depending on the relevant species and site conditions. Firebreaks may be mowed or disced in an approximately 12-foot band around the exterior of a site. Internal fire breaks may be appropriate for larger sites. All herbicide application will be conducted in a manner consistent with product labeling and applicable laws including application by a licensed Pest Control Advisor if appropriate.

- **Pest Management**—Pest management may include the mechanical control of insects, rodents and other animals. Mechanical removal (trapping) of rodents and other animals may be appropriate in or around structures that exist on excess properties. Mechanical removal of animals will be conducted by a licensed Pest Control Advisor and after obtaining any appropriate local approvals. Rodenticide will not be used for the control of animals.

  Chemical control of insects may occur in or around buildings on excess property or in agricultural areas to control pest species. Any pesticide application will be conducted in a manner consistent with product labeling and applicable laws including application by a licensed Pest Control Advisor if appropriate and after obtaining any appropriate local approvals.

- **Site Security**—Site Security will primarily consist of the installation of fencing around properties. The installation of fencing may be appropriate on properties where structures will remain or where there is a safety and security concern or particular risk of trespass. Fencing will consist of 6- to 12-foot-high chain-link fencing and may include barbed wire or similar features at the top. Fenceposts may be either metal or wood and require an excavation up to 4 inches in diameter and 3 feet deep. Other security devices such as security lighting, an alarm system, or cameras may be implemented if specific conditions require it. If buildings or other structures are present on the site, windows and doors may be boarded up to prevent trespass. "No Trespassing" or similar signs may be posted as appropriate.

  Site security will also involve the periodic inspection of excess properties for signs of trespass and the removal of any accumulated trash or dumping.

- **Structure Maintenance**—If buildings or other structures remain onsite, they will be maintained in a clean and orderly condition so as not to detract from the general appearance of the neighborhood. If the property is rented or leased, maintenance activities will be undertaken as needed to ensure the health and safety of occupants. Maintenance and repair activities may include exterior and interior painting, yard maintenance, repair or replacement of plumbing, electrical facilities, roofs, windows, heaters, and built-in appliances and other similar activities.

Table 2-24 identifies potential construction staging and laydown areas, and pre-casting yards, as well as batch plant, rock crushing, and rail storage and welding areas included within the preliminary engineering design. Figure 2-67 shows a typical pre-casting yard layout, including estimated size requirements for each element.

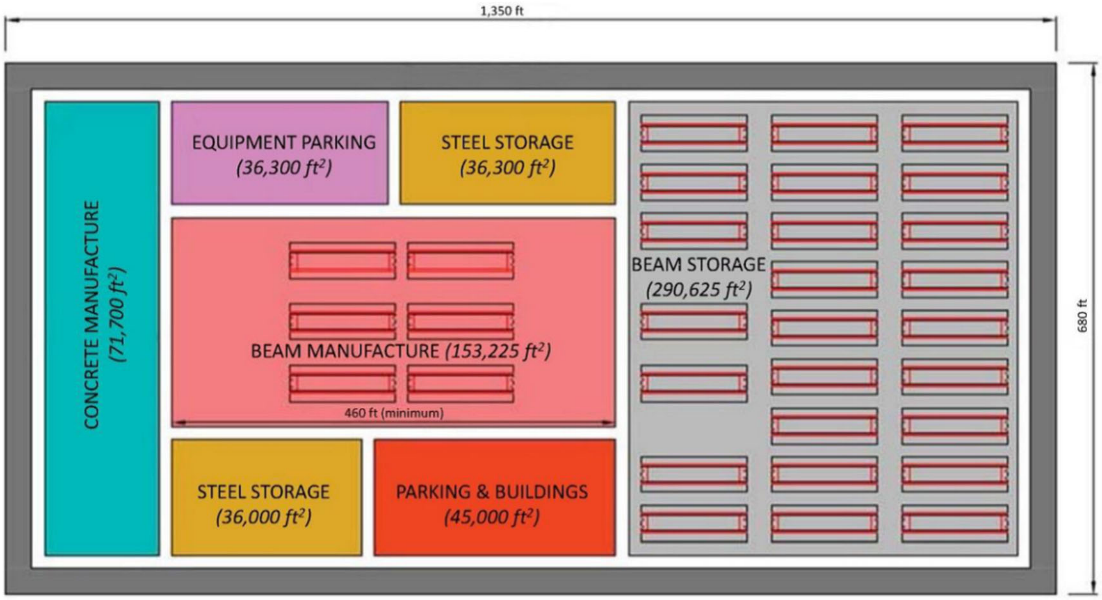
Table 2-24 Construction Staging and Pre-Casting Yards by Area for B-P Build Alternatives[1]

Type	Size	Jurisdiction	Location	B-P Build Alternative
Bakersfield				
Staging Area (CS-1)	6.1 acres	Bakersfield	South of E Brundage Lane, between an unpaved road and Vineland Road	All B-P Build Alternatives
Edison				
Laydown (CL-1)	1.2 acres	Edison	South of the SR 58 southbound exit ramp, west of Edison Road	All B-P Build Alternatives
Laydown (CL-2)	0.7 acre	Edison	South of SR 58, between Malaga Road and an unpaved road	All B-P Build Alternatives
Laydown (CL-3)	1.0 acre	Edison	Southeast of the SR 58/ Comanche Drive interchange	All B-P Build Alternatives
Laydown (CL-4)	1.1 acres	Edison	Southeast of the SR 58/ Towerline Road interchange	All B-P Build Alternatives
Staging, Rock Crushing, and Pre-Cast Area (CS/RC/POY-1)	45.1 acres	Kern County	South of Bena Road, between Towerline Road and Neumarkel Road (north of SR 58)	All B-P Build Alternatives
Rail Storage and Welding Area (RS and WA-1)	12 acres	Kern County	South of Edison Highway, between Towerline Road and Neumarkel Road (north of SR 58)	All B-P Build Alternatives

Type	Size	Jurisdiction	Location	B-P Build Alternative
Laydown (CL-6)	6.0 acres	Kern County	North of SR 58 and west of Bena Road	All B-P Build Alternatives
Laydown (CL-7)	5.1 acres	Kern County	North of SR 58, between Bena Road and Caliente Bodfish Road	All B-P Build Alternatives
Laydown (CL-8)	4.9 acres	Kern County	North of SR 58, between Caliente Bodfish Road and Bealville Road	All B-P Build Alternatives
Keene				
Laydown (CL-9)	4.6 acres	Kern County	North of SR 58 and south of the UPRR tracks, between Bealville Road and Cummings Tower access	All B-P Build Alternatives
Staging Area (CS-2)	9.5 acres	Keene	East and north of SR 58, northwest of the community of Keene	All B-P Build Alternatives
Laydown (CL-10)	3.3 acres	Keene	East and north of SR 58, northeast of the community of Keene	All B-P Build Alternatives
Tehachapi				
Laydown (CL-11)	3.3 acres	Tehachapi	East and north of SR 58, north of the City of Tehachapi	All B-P Build Alternatives
Staging, Rock Crushing, and Pre-Cast Area (CS/RC/POY-2)	151.6 acres	Tehachapi	South of E Valley Boulevard, between Turf Street and Steuber Road, and north of Abajo Avenue	All B-P Build Alternatives
Rail Storage and Welding Area (RS and WA-2)	12.0 acres	Tehachapi	South of White Oak Drive, between Steuber Road and Orchard Street, and north of Highline Road	All B-P Build Alternatives
Laydown (CL-12)	3.3 acres	Kern County	South of SR 58, between Tehachapi Willow Springs Road and Jameson Street	Alternatives 1, 2, and 5
Laydown (CL-12)	3.3 acres	Kern County	South of SR 58, between Tehachapi Willow Springs Road and Jameson Street (north of Alternatives 1, 2, and 5 laydown area)	Alternative 3
Mojave				
Laydown (CL-13)	3.3 acres	Kern County	South of Oak Creek Road and east of Tehachapi Willow Springs Road	Alternatives 1, 2, and 5
Laydown (CL-13)	3.3 acres	Kern County	South of Oak Creek Road and west of Tehachapi Willow Springs Road (west of Alternatives 1, 2, and 5 laydown area)	Alternative 3

Type	Size	Jurisdiction	Location	B-P Build Alternative
Staging, Rock Crushing, and Pre-Cast Area (CS/RC/POY-3)	24.8 acres	Kern County	South of W Avenue B, between 35th Street W and 30th Street W	All B-P Build Alternatives
Rail Storage and Welding Area (RS and WA-3)	15.5 acres	Los Angeles County	South of W Avenue B, between 40th Street W and 30th Street W, and north of W Avenue C	All B-P Build Alternatives
Lancaster				
Staging Area (CS-3)	16.0 acres	Lancaster	South of the W Avenue G, between 10th Street W and Sierra Highway	All B-P Build Alternatives
Laydown (CL-16)	1.4 acres	Lancaster	North of W Avenue H, between 10th Street W and 7th Street W, and west of Sierra Highway	All B-P Build Alternatives
Laydown (CL-17)	1.3 acres	Lancaster	South of E Avenue I, between Elm Avenue and Sierra Highway	All B-P Build Alternatives
Laydown (CL-18)	0.5 acre	Lancaster	South of W Milling Street, between Cedar Avenue and Beech Avenue, and west of Sierra Highway	All B-P Build Alternatives
Laydown (CL-19)	1.6 acres	Lancaster	South of W Avenue J, between Sierra Highway and Division Street, and east of Sierra Highway	All B-P Build Alternatives
Staging Area (CS-4)	12.6 acres	Lancaster	South of W Avenue K, between a dirt road and Sierra Highway, west of Sierra Highway	All B-P Build Alternatives
Laydown (CL-21)	1.9 acres	Lancaster	North of W Avenue L, between Sierra Highway and Division Street, east of Sierra Highway	All B-P Build Alternatives
Palmdale				
Laydown (CL-22)	1.5 acres	Palmdale	Southeast of the E Avenue M/ Sierra Highway intersection, east of Sierra Highway	All B-P Build Alternatives

Source: California High-Speed Rail Authority, 2017b
[1] Stockpiling would occur in both laydown and staging areas.
B-P = Bakersfield to Palmdale Project Section
CL = Construction Laydown
CS = Construction Staging
POY = Pre-Cast Operations Yard
RC = Rock Crushing
SR = State Route
UPRR = Union Pacific Railroad
WA = Welding Area



Source: California High-Speed Rail Authority, 2017b

Figure 2-67 Typical Pre-Casting Yard Layout

2.8.5 Major Construction Activities

This section describes the major types of construction activities for the Bakersfield to Palmdale Project Section.

2.8.5.1 Earthwork

Earth support is an important factor in constructing deep excavations that would be necessary in some portions of the project section. There are three general excavation support categories:

- **Open-Cut Slope**—Open-cut slope is used in areas where sufficient room is available to open-cut the area and slope the sides back to meet the adjacent existing ground surface. The slopes are designed similar to any cut slope, taking into account the natural slope of adjacent ground material and ground stability in the area.
- **Temporary**—Temporary excavation support structures are designed and installed to support vertical or near-vertical faces of the excavation in areas where space is not available for open-cut slope. These structures do not contribute to the final load-carrying capacity of the tunnel or trench structure and are either abandoned in place or dismantled as the excavation is backfilled. Generally, they consist of soldier piles and lagging, sheet-pile walls, slurry walls, secant piles, or tangent piles.
- **Permanent**—Permanent structures are designed and installed to support vertical or near-vertical faces of the excavation in areas where space is not available for open-cut slope. This type of structure forms part of the permanent final structure. Generally, it consists of slurry walls, secant piles, or tangent-pile walls.

Earthwork is the disturbance of soil or earth by any means, including excavation (including subsurface), tunneling, drilling, infilling, stockpiling, dumping of soil or sand, and construction/ reconstruction of any track, embankment, or drainage channel. Earthwork construction would be performed in a manner to achieve a balanced condition where the quantity of soil or earthen materials removed through excavation would be roughly equal to the quantity of material being placed in embankments. The adjustment of the ratio of excavation to embankment to achieve this balance would be performed by variations in cut-slope ratios, embankment widths, and embankment slope ratios during construction as existing ground conditions are revealed. Cut material and tunnel spoils would likely be stored and processed on-site and used as fill materials if deemed suitable by the site geotechnical engineer. It is not anticipated that any excavated materials would need to be exported to off-site locations for the B-P Build Alternatives.

To develop the balanced earthwork condition for the design of the B-P Build Alternatives (see the Record Set PEPD Design Submission Bakersfield to Palmdale Alignment [Plan and Profile], October 2017, in Volume III of this EIR/EIS), project engineers completed earthwork designs in accordance with the programmatic requirements of the Authority's Technical Memorandum 2.6.7 (Earthwork and Track Bed Design Guidelines). In order to balance the earthwork, slopes were modeled in accordance with Technical Memorandum 2.6.7 for embankments (fill slopes), cut slopes in soil, and cut slopes in fault zone areas. The results of the initial earthwork analysis showed a balanced earthwork condition for Alternatives 1, 2, and 5, but Alternative 3 was unbalanced, with a net export of about 15 million cubic yards of soil. To achieve a balanced earthwork condition for Alternative 3, refinements were made to the design of Alternative 3, including using steeper embankment slopes within the Antelope Valley and extending the south end of Tunnel 9 by an additional 7,750 feet. These design refinements resulted in a balanced earthwork condition for Alternative 3; therefore, none of the B-P Build Alternatives (with or without the CCNM Design Option) would require any hauling of excess soil material off site. With the addition of the Refined CCNM Design Option, the earthwork balance is not achievable due to profile changes and results in a range of about 2 to 14 million cubic yards of excess materials, depending on which of the B-P Build Alternative alignments the Refined CCNM Design Option is coupled with. Those materials would be stockpiled in the area north of SR 58 in the vicinity of Bealville Road, where additional footprint has been identified (see previous Figure 2-63).

2.8.5.2 Bridge, Aerial Structure, Road Crossing, and Wildlife Crossing Construction

Similar to existing HSR systems around the world, it is anticipated that the elevated guideways would be designed and built as single-box segmental girder construction. Where needed, other structural types would be considered and used, including steel girders, steel truss, and cable-supported structures. The following provides an overview of the construction methods required for foundations, substructures, and superstructures of bridges, aerial structures, and roadway crossings:

- **Foundations**—A typical aerial structure foundation pile cap is supported by an average of four large-diameter bored piles with diameters ranging from 5 feet to 9 feet. Depth of piles depends on geotechnical site conditions. Pile construction can be achieved by using rotary drilling rigs, and either bentonite slurry or temporary casings may be used to stabilize pile shaft excavation. The estimated pile production rate is 4 days per pile installation. Additional pile installation methods available to the contractor include bored piles, rotary drilling cast-in-place piles, driven piles, and a combination of pile jetting and driving.

  Upon completing the piles, pile caps can be built using conventional methods. For pile caps constructed near existing structures, such as railways, bridges, and underground drainage culverts, temporary sheet piling (i.e., temporary walls) can be used to minimize disturbances to adjacent structures. Sheet piling installation and extraction are anticipated to be achieved using hydraulic sheet-piling machines.

- **Substructure**—Typical aerial structures of up to 90 feet would be built using cast-in-place concrete bent caps and columns supported upon pile caps with large-diameter cast-in-drilled hole piles. A climbing formwork system may be used to construct piers and portal beams over 90 feet high. The self-climbing formwork system is equipped with a winched lifting device, which is raised up along the column by hydraulic means with a structural frame mounted on top of the previous pour. In general, a 3-day cycle for each 12-foot pour height can be achieved. The final size and spacing of the piers depends on the type of superstructure and spans they are supporting.

- **Superstructure**—It would be necessary to consider the loadings, stresses, and deflections encountered during the various intermediate construction stages, including changes in static scheme, sequence of tendon installation, maturity of concrete at loading, and load effects from erection equipment. As a result, the final design would depend on the contractor's means and methods of construction and can include several different methods, such as span-by-span, incrementally launched, progressive cantilever, and balanced cantilever.

Road crossings of existing railroads, roads, and the HSR would be built on the line of the existing road or offline at some locations. When built online, the existing road would be closed or temporarily diverted. When built offline, the existing road would be maintained in use until the new crossing is completed. Where new roadway underpasses of existing railroads are required, a temporary shoofly track would be built to maintain railroad operations during underpass construction.

Wildlife structures would also include dedicated overcrossings or concrete arch undercrossings. Where bridges, aerial structures, and road crossings coincide with proposed dedicated wildlife crossing structures, such features would serve the function of, and supersede the need for, dedicated wildlife crossing structures or dual-purpose road and wildlife crossings. These crossings would include fencing designed to prevent wildlife from entering the road. In instances where these aerial structures are changed to embankments, they would no longer function as wildlife crossings.

Construction of foundations and the substructure would be similar to construction of the aerial structures but on a smaller scale. The superstructure would likely be built using pre-cast, pre-stressed, concrete girders and cast-in-place deck. Approaches to the bridges would be earthwork embankments, mechanically stabilized earth walls, or other retaining structures.

2.8.5.3 Roadway Detours

Some proposed grade separations at major arterials are close to one another and would require roadway detours during construction. To facilitate the construction of the roadway grade separations in these areas, it is anticipated that the contractor would phase the construction by closing and building every other arterial, as described below.

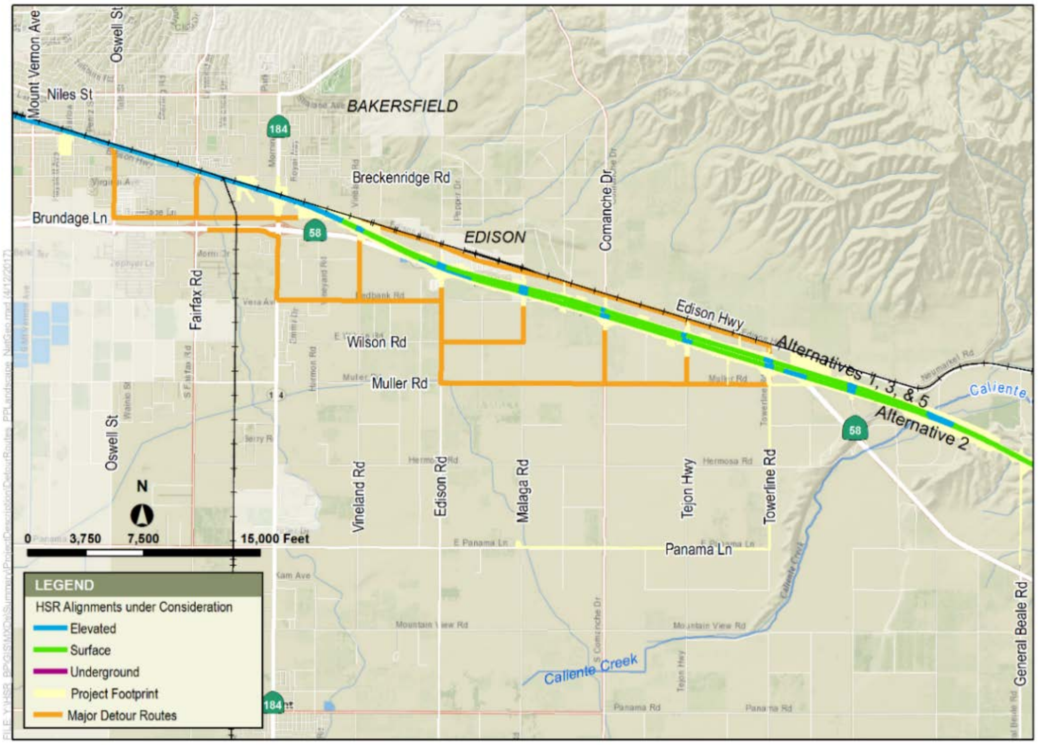
- **Edison Area**—As shown on Figure 2-68, in the Edison area, major arterials are spaced about 1 mile apart, starting on the north end with Vineland Road and ending at Towerline Road. Under Alternatives 1, 3, and 5, the first phase of construction of the Bakersfield to Palmdale Project Section would include the closure and construction of Vineland Road, Malaga Road, and Tejon Highway. The second phase of construction would include the closure and construction of Edison Road, Comanche Drive, and Towerline Road.

  Under Alternative 2, only Vineland Road would need to be closed during the construction of the grade separation; all other arterials could remain open during construction, including both crossings of SR 58.

- **Lancaster Area**—As shown on Figure 2-69, in the Lancaster area, major arterials are spaced 1 mile apart, starting on the north end with Avenue G and ending at Avenue M. Under Alternatives 1, 2, 3, and 5, the first phase of construction of the Bakersfield to Palmdale Project Section would include the closure and construction of Avenues G, I, K, and M. The second phase of construction would include the closure and construction of Avenues H, J, and L.

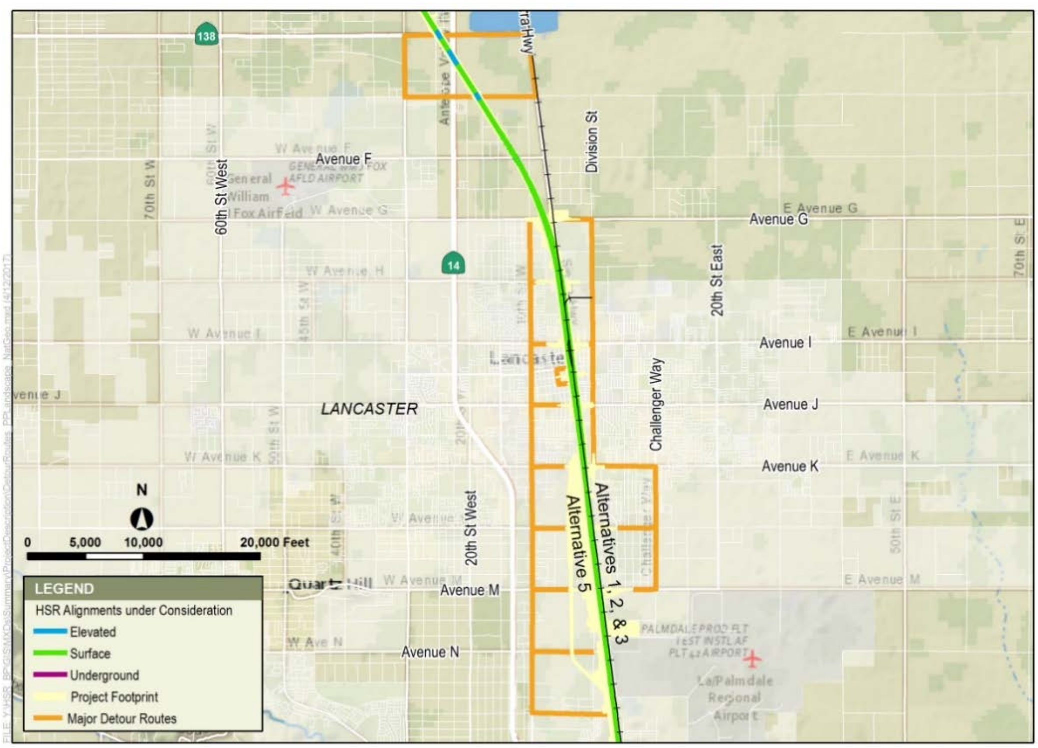
  Under Alternatives 1, 2, and 3, approximately 4.5 miles of Sierra Highway, from north of Avenue K to Avenue O, would be relocated to the west. Under Alternative 5, Sierra Highway would need to be relocated for approximately 8.5 miles from north of Avenue G to Avenue O. These relocations could be built with minimal disruption to the existing traffic. Once the relocations are complete, all traffic could be shifted to the relocated Sierra Highway.

  Construction of foundations and substructures would be similar to construction of the aerial structures but reduced in size. The superstructure would likely be built using pre-cast, pre-stressed, concrete girders and cast-in-place deck. Approaches to the bridges would be earthwork embankments, mechanically stabilized earth wall, or other retaining structures.



Source: California High-Speed Rail Authority, 2020

Figure 2-68 Edison Area Detour Map



Source: California High-Speed Rail Authority, 2020

Figure 2-69 Lancaster Area Detour Map

2.8.5.4 Tunnels

Tunnel construction would occur at various locations in the Bakersfield to Palmdale Project Section, primarily in the Tehachapi Mountains. Either of two basic configurations may be used: a single, large tunnel containing two tracks or two smaller tunnels with a single track in each tunnel. The selected configuration would depend on alignment, ground conditions, construction method, portal configuration, approach structures, fire and life safety, and operations and maintenance considerations.

The primary methods for tunnel construction are the sequential excavation method, cut-and-cover, and the TBM method. The sequential excavation method uses drilling and blasting excavation or excavator-type equipment that produces an arched tunnel cross section. Cut-and-cover is built by open-cut methods to create standalone structures where soil conditions are questionable or the amount of overburden is less than desirable. A TBM is typically used when tunnels exceed 1 mile in length to make the purchase and mobilization of a TBM economical. As shown in Table 2-25, the sequential excavation method, drill and blast construction, and TBM construction would progress at rates of approximately 10, 20, and 45 feet per day, respectively. (Table 2-25 also identifies the tunnel numbers for each alternative in the project section.) Total utilized equipment for each method would require approximately 10 operating hours per day. Surface disruption would occur with construction of tunnel portals and cut-and-cover tunnels. A cut-and-cover tunnel is proposed for all B-P Build Alternatives at the beginning of Tunnel No. 3. An additional cut-and-cover tunnel is proposed for Alternative 3 at the end of Tunnel No. 9. The impacts of surface disruption are discussed in the applicable EIR/EIS sections (e.g., Section 3.3, Air Quality and Global Climate Change; Section 3.4, Noise and Vibration; Section 3.10, Hazardous Materials and Wastes; and Section 3.7, Biological Resources and Aquatic Resources) in Chapter 3.

Table 2-25 Tunnel Excavation

Tunnel Number	Tunnel Length (feet)	Excavation Method	Approximate Progress Rate (feet/day)	Duration to Mine (days)	Total Utilized Equipment Operating (hours per day)
Alternatives 1, 2, and 5					
1	1,500	SEM	10	150	10
2	1,630	SEM	10	163	10
3	2,000	SEM	10	200	10
4	6,000	D&B	20	300	10
5	1,750	D&B	20	88	10
6	5,250	D&B	20	263	10
7	8,200	TBM	45	182	10
8	14,100	TBM	45	312	10
9	9,500	TBM	45	249	10
Alternative 3					
1	1,500	SEM	10	150	10
2	1,630	SEM	10	163	10
3	2,000	SEM	10	200	10
4	6,000	D&B	20	300	10
5	1,750	D&B	20	88	10
6	5,250	D&B	20	263	10
7	8,200	TBM	45	182	10

Tunnel Number	Tunnel Length (feet)	Excavation Method	Approximate Progress Rate (feet/day)	Duration to Mine (days)	Total Utilized Equipment Operating (hours per day)
8	13,441	TBM	45	299	10
9	13,000	TBM	45	289	10
CCNM Design Option[1]					
5	3,319	D&B	20	166	10
6	4,306	D&B	20	215	10

[1] The data for the CCNM Design Option represent the totals for Tunnel Nos. 5 and 6 for each alternative with the CCNM Design Option.
D&B = drill and blast TBM = tunnel boring machine
SEM = sequential excavation method

2.8.5.5 Railroad Systems Construction

The railroad systems would include trackwork, traction electrification, signaling, and communications. Trackwork is the first rail system to be built after completion of earthwork and structures, and it must be in place at least locally to start traction electrification and railroad signalizing installation. Trackwork construction generally requires the welding of transportable lengths of steel running onto longer lengths (approximately 0.25 mile). These are placed in position on crossties or track slabs and field-welded into continuous lengths.

Both tie and ballast as well as slab-track construction would be used. Tie and ballast construction, which would be used for surface and minor structures, typically uses crossties and ballast that are distributed along the trackbed by truck or tractor. In sensitive areas, such as where the HSR would be parallel to or near streams, rivers, or wetlands, and in areas of limited accessibility, this operation may be accomplished by using the established right-of-way with material delivery via the constructed rail line. For major civil structures, slab-track construction would be used. Slab-track construction is a nonballasted track form employing pre-cast track supports.

Traction electrification equipment to be installed includes TPSSs and the OCS. TPSSs are typically fabricated and tested in a factory, then delivered by tractor-trailer to a prepared site adjacent to the alignment. It is assumed that substations would be located every 30 miles along the alignment. The OCS is assembled in place over each track and includes poles, brackets, insulators, conductors, and other hardware.

Signaling equipment to be installed includes wayside cabinets and bungalows, communications towers, wayside signals (at track interlocking), switch machines, insulated joints, impedance bounds, and connecting cables. The equipment would support automatic train protection, enhanced ATC, and positive train control to control train[17] separation, routing at interlocking, and speed.

2.8.5.6 Station Construction

HSR stations for the Bakersfield to Palmdale Project Section would be newly constructed.[18] Existing train operations, including station capacity and passenger levels of service, would be maintained during construction. HSR stations require significant coordination and planning to accommodate safe and convenient access to existing businesses and residences and to accommodate traffic control during construction periods. Section 2.5.2.2 provides additional information about the station areas. The typical construction sequence would be as follows:

[17] Positive train control infrastructure consists of integrated command, control, communications, and information systems for controlling train movements. It improves railroad safety by significantly reducing the probability of collisions between trains, casualties to roadway workers and damage to their equipment, and over-speed accidents.

[18] The existing Palmdale Transportation Center would be expanded to the south to accommodate the HSR system.

- **Demolition and Site Preparation**—The contractor would construct detour roadways, new station entrances, construction fences and barriers, and other elements required due to taking existing facilities on the worksite out of service. The contractor would perform street improvement work, site clearing and earthwork, drainage work, and utility relocations. Additionally, maintenance facilities are assumed to be newly constructed structures. For platform improvements or additional platform construction, the contractor may be required to realign existing track.
- **Structural Shell and Mechanical/Electrical Rough-Ins**—For these activities, the contractor would construct foundations and erect the structural frame for the new station, enclose the new building, and/or construct new platforms and connect the structure to site utilities. Additionally, the contractor would rough-in electrical and mechanical systems and install specialty items such as elevators, escalators, and ticketing equipment.
- **Finishes and Tenant Improvements**—The contractor would install electrical and mechanical equipment, communications and security equipment, finishes, and signage. Additionally, the contractor may install other tenant improvements if requested.

2.9 Permits and Approvals

The Authority has prepared, or is in the process of preparing, agreements with environmental resource agencies to facilitate the environmental permitting required during final design and construction. The agreements currently in place clearly identify the Authority's responsibilities in meeting the permitting requirements of the federal, state, and regional environmental resource agencies. Likewise, similar agreements currently being prepared would clearly identify those responsibilities. The U.S. Army Corps of Engineers has determined that aquatic features within this project section are not subject to regulation under Section 404 of the Clean Water Act (U.S. Army Corps of Engineers 2017).

Table 2-26 lists the major environmental permits required for the HSR project (as of January 2021). The table identifies each agency's status as a NEPA cooperating agency or a CEQA responsible agency. As a state agency, the Authority is exempt from local permit requirements; however, in order to coordinate construction activities with local jurisdictions, the Authority would seek local permits as part of construction processes consistent with local ordinances. The agencies identified in the table are anticipated to rely on the EIR/EIS documents to support their permitting and approval processes.

Table 2-26 Potential Major Environmental Reviews, Permits, and Approvals

Agency	Reviews, Permits, and Approvals
Federal	
U.S. Department of the Interior/Authority	▪ Section 4(f) of the U.S. Transportation Act of 1966, NEPA
National Park Service	▪ Section 106 Consultation (National Historic Preservation Act of 1966)
U.S. Advisory Council on Historic Preservation	▪ Section 106 Consultation (National Historic Preservation Act of 1966)
U.S. Environmental Protection Agency	▪ General Conformity Determination (coordination)
U.S. Fish and Wildlife Service	▪ Federal Endangered Species Act Section 7 Consultation and Biological Opinion
U.S. Department of the Interior Bureau of Land Management (NEPA cooperating agency)	▪ Right-of-way grant for crossing federal sovereign lands
Surface Transportation Board (NEPA cooperating agency)	▪ Authorization to construct and operate new rail line pursuant to 49 U.S.C. 10901 or 49 U.S.C. 10502, as applicable
U.S. Forest Service	▪ Section 4(f) of the U.S. Transportation Act of 1966 (coordination)

Agency	Reviews, Permits, and Approvals
State	
California Historic State Historic Preservation Officer	▪ Section 106 Consultation (National Historic Preservation Act of 1966)
California Department of Fish and Wildlife (CEQA responsible agency)	▪ California Endangered Species Act Incidental Take Permit Section 2081 ▪ California Department of Fish and Wildlife Section 1602 Lake and Streambed Alteration Agreement
Caltrans (CEQA responsible agency)	▪ Caltrans Encroachment Permits ▪ Caltrans Statewide Stormwater Permit (Order No. 2012-0011-DWQ, NPDES No. CAS000003)
California Public Utilities Commission (CEQA responsible agency)	▪ Approval for construction and operation of a railroad crossing of a public road and for construction of new transmission lines, electrical upgrades, and substations
California State Lands Commission (CEQA responsible agency)	▪ Lease for crossing state sovereign lands
State Water Resources Control Board, Central Valley and Lahontan Regional Water Quality Control Boards (CEQA responsible agencies)	▪ Phase II Small MS4 Permit (Order No. 2013-0001-DWQ) ▪ Porter-Cologne Water Quality Control Act Waste Discharge Requirement Construction General Permit (Order No. 2012-0006-DWQ, NPDES No. CAS000002) ▪ General Industrial Permit (Order No. 2014-0057-DWQ, NPDES No. CAS000001)
Regional	
Antelope Valley Air Quality Management District	▪ Rule 109: Recordkeeping for VOC Emissions ▪ Rule 402 – Fugitive dust
San Joaquin Valley Air Pollution Control District (CEQA responsible agency)	▪ Rule 2210: New and Modified Stationary Source Review; Rule 2280: Portable Equipment Registration; Rule 8011: Fugitive Dust Emission Sources; Rule 9510 Indirect Source Review
Central Valley Regional Water Quality Control Board (CEQA responsible agency)	▪ Dewatering Permit (Order No. R5-2013-0074, NPDES No. CAG995001)
Lahontan Regional Water Quality Control Board (CEQA responsible agency)	▪ Dewatering Permit (Order No. R6T-2014-0049 NPDES No. CAG996001) ▪ Dewatering Permit (Order No. R6T-2010-0024, NPDES No. CAG916001)
Eastern Kern Air Pollution Control District	▪ Rule 403 – Fugitive dust

Caltrans = California Department of Transportation
CEQA = California Environmental Quality Act
DWQ = Division of Water Quality
MS4 = Municipal Separate Storm Sewer System
NEPA = National Environmental Policy Act
NPDES = National Pollutant Discharge Elimination System
U.S.C. = United States Code
VOC = volatile organic compound