California High-Speed Rail Authority

Bakersfield to Palmdale Project Section

Final Environmental Impact Report/ Environmental Impact Statement

Appendix 2-D: Applicable Design Standards

May 2021

CALIFORNIA High-Speed Rail Authority

The environmental review, consultation, and other actions required by applicable Federal environmental laws for this project are being or have been carried out by the State of California pursuant to 23 U.S.C. 327 and a Memorandum of Understanding dated July 23, 2019, and executed by the Federal Railroad Administration and the State of California.

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Table 2-D-1 Transportation

Impact Category	Project Features	Applicable Design Standards
Alteration of existing state and local roadways	Alignment (bridges and viaducts)	*Bakersfield to Palmdale Project Section: Transportation Technical Report* International Electrotechnical Commission FRA Standards and Guidelines Federal Emergency Management Agency Guidelines FHWA Guidelines National Earthquake Hazards Reduction Program U.S. Army Corps of Engineers Guidelines U.S. Bureau of Land Management Surveying Manual U.S. Geological Survey Standards AASHTO *Highway Drainage Guidelines* AREMA *Manual for Railway Engineering* *California Disabled Accessibility Guidebook* California Seismic and Safety Commission Standards and Guidelines California Occupational Safety and Health Administration Standards Caltrans Bridge Design Manuals Caltrans *Seismic Design Criteria,* Version 1.4 *Caltrans Highway Design Manual* • Chapter 80—Application of Design Standards • Chapter 200—Geometric Design • Chapter 300—Geometric Cross-Section • Chapter 400—Intersections At Grade Caltrans *Plans Preparation Manual* Caltrans *Project Development Procedures Manual* Caltrans *Standard Plans* Caltrans *Surveys Manual* Caltrans *Transportation Management Planning Guidelines* *Caltrans User's Guide to Photogrammetric Products and Services* Caltrans *Right of Way Manual,* and Forms and Exhibits BNSF Railway Engineering Standards Union Pacific Railroad Engineering Standards Amtrak Standards and Guidelines Southern California Regional Rail Authority Engineering Standards Public Utilities Commission(s) Regional Water Quality Control Boards Air Quality Districts Flood Control Districts

AASHTO = American Association of State Highway and Transportation Officials
AREMA = American Railway Engineering and Maintenance-of-Way Association
Caltrans = California Department of Transportation
FHWA = Federal Highway Administration
FRA = Federal Railroad Administration

Table 2-D-2 Air Quality

Impact Category	Project Features	Applicable Design Standards
Construction	HSR civil work and track construction (alignment, bridges, and viaducts)	*Bakersfield to Palmdale Project Section: Air Quality and Global Climate Change Technical Report* The HSR project shall comply with the CARB, including the following California air basins: • Sacramento Valley • San Francisco Bay Area • San Joaquin Valley • Mojave Desert • South Coast • San Diego County Emissions shall be tracked by CARB and include ozone, carbon monoxide, carbon dioxide, hydrogen sulfate, methane, NO_X, $PM_{2.5}$, M_{10}, sulfur dioxide, and lead.
Operations	HSR operations	*Bakersfield to Palmdale Project Section: Air Quality and Global Climate Change Technical Report* HSR shall comply with CARB, including the following California air basins: • Sacramento Valley • San Francisco Bay Area • San Joaquin Valley • Mojave Desert • South Coast • San Diego County Emissions shall be tracked by CARB and include ozone, carbon monoxide, carbon dioxide, hydrogen sulfate, methane, NO_X, $PM_{2.5}$, PM_{10}, sulfur dioxide, and lead.

CARB = California Air Resources Board
HSR = high-speed rail
NO_X = nitrogen oxides
$PM_{2.5}$ = particulate matter smaller than or equal to 2.5 microns in diameter
PM_{10} = particulate matter smaller than or equal to 10 microns in diameter

Table 2-D-3 Noise and Vibration

Impact Category	Project Features	Applicable Design Standards
Construction	HSR civil work and track construction (alignment, bridges and viaducts)	*Bakersfield to Palmdale Project Section: Noise and Vibration Technical Report* FRA *High-Speed Ground Transportation Noise and Vibration Impact Assessment Manual*
Operations	Alignment (bridges and viaducts)	*Bakersfield to Palmdale Project Section Noise and Vibration Technical Report* FRA *High-Speed Ground Transportation Noise and Vibration Impact Assessment Manual*

FRA = Federal Railroad Administration
HSR = high-speed rail

Table 2-D-4 Electromagnetic Interference/Electromagnetic Fields

Impact Category	Project Features	Applicable Design Standards
Electromagnetic compatibility of HSR equipment and facilities with themselves, and with the equipment and facilities of HSR system neighbors.	HSR systems	Code of Federal Regulations Title 46, Part 15, Subpart B, Sections 15.107(a) and 15.109(b) for Class A digital devices CENELEC Standard EN 50121-4, Railway Applications—Electromagnetic Compatibility, Part 4: Emissions and Immunity of Signaling and Telecommunications Apparatus
Electromagnetic compatibility of HSR equipment and facilities with passengers, workers, and neighbors of the HSR system.	HSR systems	IEEE Standard C95.6-2002—IEEE Standard for Safety Levels with Respect to Human Exposure to Electromagnetic Fields, 0–3 kHz IEEE Standard C95.1-2005—IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz FCC Office of Engineering and Technology Bulletin 65, Edition 91-01—Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields

CENELEC = European Committee for Electrotechnical Standardization
FCC = Federal Communications Commission
GHz = gigahertz
HSR = high-speed rail
IEEE = Institute of Electrical and Electronics Engineers
kHz = kilohertz

Table 2-D-5 Public Utilities and Energy

Impact Category	Project Features	Applicable Design Standards
New construction and the protection, support, restoration, and rearrangement of utilities	Alignment (bridges and viaducts)	Code of Federal Regulations, Title 49, California Public Utilities Commission General Orders, Public Utility Codes, Rules of Practice and Procedure, and the Policies and Guidelines National Fire Protection Association Standards Caltrans *Highway Design Manual* • Chapter 80—Application of Design Standards • Chapter 200—Geometric Design • Chapter 300—Geometric Cross Section • Chapter 400—Intersections At Grade Caltrans *Plans Preparation Manual* Caltrans *Project Development Procedures Manual* AREMA *Manual for Railway Engineering* Conformance with the latest technical specifications and practices of the respective utility owner. American National Standards Institute Standards: • Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications • Standard for Outside Plant Communications Cable • Communications Wire and Cable for Wiring of Premises • Standard for Fiber-Optic Premises Distribution Cable • Human Factors Engineering Requirements for Visual Display Terminal Work Stations • Standard for Tolerance of Radiated Electromagnetic 1 Frequency Interference Electronic Industries Association/Telecommunications Industry Association Standards

Impact Category	Project Features	Applicable Design Standards
		Underwriter Laboratories Inc. publications U.S. Department of Defense Standards: • MIL-STD-1472: Human Engineering • MIL-STD-781: Reliability, Test Methods, Plans, and Environments for Engineering, 12 Development, Qualification and Production • MIL-STD-810: Department of Defense • Test Method Standard for Environmental Engineering Considerations and Laboratory Tests National Transportation Communications for Intelligent Transportation System Protocol Standards Telecommunication Standardization Sector Standards
Stations and maintenance facility buildings	HSR stations and maintenance facility buildings	HSR stations and maintenance facility buildings shall be designed to achieve net-zero site energy, as measured over the course of one year.

AREMA = American Railway Engineering and Maintenance-of-Way Association
Caltrans = California Department of Transportation
HSR = high-speed rail

Table 2-D-6 Hydrology

Impact Category	Project Features	Applicable Design Standards
Alteration of stream flows and water surface elevations from the placement of structures (e.g., piers and abutments) within stream channels	Alignment (bridges and viaducts), including access track to heavy maintenance facility	*Bakersfield to Palmdale Project Section: Draft PEPD Hydrology, Hydraulics & Drainage Report* *Bakersfield to Palmdale Project Section: Draft PEPD Floodplain Impact Report* Caltrans *Highway Design Manual:* • Chapter 810—Hydrology • Chapter 820—Cross Drainage FHWA Hydraulic Design Series: • HDS-1—Hydraulics of Bridge Waterways • HDS-5—Hydraulic Design of Highway Culverts AREMA *Manual for Railway Engineering* AASHTO *Highway Drainage Guidelines*
Alteration of drainage patterns from placement of any type of project feature in any location. Includes changes from impervious surfaces and floodplain impacts	All project features	Stormwater Pollution Prevention Plan: • Hydromodification *Bakersfield to Palmdale Project Section: Draft PEPD Hydrology, Hydraulics & Drainage Report* *Bakersfield to Palmdale Project Section: Draft PEPD Floodplain Impact Report* *Bakersfield to Palmdale Project Section: Stormwater Management Report* Caltrans *Highway Design Manual:* • Chapter 820—Cross Drainage • Chapter 830—Roadway Drainage • Chapter 860—Open Channels

Impact Category	Project Features	Applicable Design Standards
		FHWA Hydraulic Design Series No. 2 (Hydrology) FHWA Hydraulic Engineering Circular No. 22 (*Urban Drainage Design Manual*) AREMA *Manual for Railway Engineering* AASHTO *Highway Drainage Guidelines*
Generation of pollution from roadways	State highway and local roadway modifications and crossings	Stormwater Pollution Prevention Plan: • Construction BMP • Post-construction controls *Bakersfield to Palmdale Project Section: Stormwater Management Report* Caltrans *Stormwater Quality Handbook:* • Project Planning and Design Guide • Stormwater Pollution Prevention Plan and Water Pollution Control Program Preparation Manual AASHTO *Highway Drainage Guidelines*
Generation of pollutants from stations	Bakersfield and Palmdale Stations	Stormwater Pollution Prevention Plan: • Construction BMPs • Post-construction controls • Local standards *Bakersfield to Palmdale Project Section: Stormwater Management Report*
Generation of pollutants from LMF and MOIF	All LMF and MOIF Alternatives	Stormwater Pollution Prevention Plan: • Construction BMPs • Industrial BMPs *Bakersfield to Palmdale Project Section: Stormwater Management Report*

AASHTO = American Association of State Highway and Transportation Officials
AREMA = American Railway Engineering and Maintenance-of-Way Association
BMP = best management practice
Caltrans = California Department of Transportation
FHWA = Federal Highway Administration
LMF = light maintenance facility
MOIF = maintenance of infrastructure facility
PEPD = Preliminary Engineering for Project Definition

Table 2-D-7 Geology, Soils, and Seismicity

Impact Category	Project Features	Applicable Design Standards
Construction	Backfilling of borings, test pits, cone penetration tests, rotosonic holes, wells, and probe holes	AASHTO Guidance • AASHTO LRFD BDS with Caltrans Amendments • AASHTO Guide Specifications for Design and Construction of Segmental Concrete Bridges • AASHTO Guide Specifications for Thermal Effects in Concrete Bridge Superstructures Caltrans • CSDC California Building Code FHWA Guidelines • FHWA Drilled Shaft Construction Procedures and LRFD Design Methods, FHWA-NHI-22 10-016 • FHWA Design and Construction of Driven Pile Foundations, Volumes 1 and 2, FHWA-HI-24 97-013 & 0-14 • FHWA Drilled Shafts: Construction and Procedures and Design Methods, FHWA-IF-99-26 02 • FHWA Mechanically Stabilized Earth Walls and Reinforced Soil Slope Design and Construction Guidelines, FHWA-NHI-00-043 • FHWA Earth Retaining 1 Structures, FHWA-NHI-99-025 • FHWA Soil Slope and Embankment Designs, FHWA-NHI-01-026 • FHWA Rock Slopes Reference Manual, FHWA-HI-99-00 • FHWA Geosynthetics Design and Construction Guidelines, FHWA-HI-95-038 California Well Standards, Water Wells, Monitoring Wells, Cathodic Protection Wells • Bulletins 74-81 and 74-90
Construction	Restoration of pavement	AASHTO Guidance • AASHTO LRFD BDS with Caltrans Amendments • AASHTO Guide Specifications for Design and Construction of Segmental Concrete Bridges • AASHTO Guide Specifications for Thermal Effects in Concrete Bridge Superstructures Caltrans • CSDC FHWA Guidelines • FHWA Drilled Shaft Construction Procedures and LRFD Design Methods, FHWA-NHI-22 10-016 • FHWA Design and Construction of Driven Pile Foundations, Volumes 1 and 2, FHWA-HI-24 97-013 & 0-14 • FHWA Drilled Shafts: Construction and Procedures and Design Methods, FHWA-IF-99-26 02 • FHWA Mechanically Stabilized Earth Walls and Reinforced Soil Slope Design and Construction Guidelines, FHWA-NHI-00-043 • FHWA Earth Retaining 1 Structures, FHWA-NHI-99-025

Impact Category	Project Features	Applicable Design Standards
		• FHWA Soil Slope and Embankment Designs, FHWA-NHI-01-026 • FHWA Rock Slopes Reference Manual, FHWA-HI-99-00 • FHWA Geosynthetics Design and Construction Guidelines, FHWA-HI-95-038

AASHTO = American Association of State Highway and Transportation Officials
AREMA = American Railway Engineering and Maintenance-of-Way Association
BDS = Bridge Design Specification
BMP = best management practice
Caltrans = California Department of Transportation
CSDC = Caltrans Seismic Design Criteria
FHWA = Federal Highway Administration
LRFD = Load and Resistance Factor Design

Table 2-D-8 Hazardous Materials

Impact Category	Project Features	Applicable Design Standards
Construction	HSR civil work and track construction (alignment, bridges, and viaducts)	*Bakersfield to Palmdale Project Section: Hazardous Materials and Waste Technical Report* Code of Federal Regulations Title 49, Part 192, "Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards" Code of Federal Regulations Title 49, Part 195, "Transportation of Hazardous Liquids by Pipeline"
Operation of the HSR system and ancillary sources	Alignment (bridges and viaducts)	*Bakersfield to Palmdale Project Section: Hazardous Materials and Waste Technical Report*

HSR = high-speed rail

Table 2-D-9 Safety and Security

Impact Category	Project Features	Applicable Design Standards
Construction	HSR civil work and track construction (alignment, bridges, and viaducts)	Code of Federal Regulations Title 49, Part 213, Section 316 for protection of the right-of-way for Class 8 and 9 tracks Code of Federal Regulations Title 49, Part 214, "Railroad Workplace Safety" California Public Utilities Commission General Order No. 26-D FRA guidelines regarding the separation and protection of adjacent transportation systems and conventional railroads FRA *High-Speed Passenger Rail Safety Strategy* (November 2009) AREMA *Manual for Railway Engineering* Caltrans *Highway Design Manual* Caltrans *Plans Preparation Manual* Caltrans *Project Development Procedures Manual*
Operation of the HSR system and ancillary sources	Alignment (bridges and viaducts)	Be fully grade-separated at crossings and fully access-controlled Incorporate supervisory control and data acquisition system Incorporate climatic and seismic monitoring systems Crime Prevention Through Environmental Design principles

AREMA = American Railway Engineering and Maintenance-of-Way Association
Caltrans = California Department of Transportation
FRA = Federal Railroad Administration
HSR = high-speed rail

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