CALIFORNIA HIGH-SPEED TRAIN

Project Environmental Impact Report / Environmental Impact Statement

DRAFT

Fresno to Bakersfield

Hydrology and Water Resources Technical Report

July 2012

CALIFORNIA High-Speed Rail Authority

U.S. Department of Transportation
Federal Railroad Administration

California High-Speed Train Project EIR/EIS

Hydrology and Water Resources Technical Report

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Acronyms and Abbreviations

°F	degree(s) Fahrenheit
afy	acre-foot/feet per year
ARRA	American Recovery and Reinvestment Act
Authority	California High-Speed Rail Authority
Basin Plan	Water Quality Control Plan for the Tulare Lake Basin
BFE	base flood elevation
bgs	below ground surface
BMP	Best Management Practice
BNSF	BNSF Railway
CCR	California Code of Regulations
CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
CIMIS	California Irrigation Management Information System
CVFPB	Central Valley Flood Protection Board
CWA	Clean Water Act
DWR	California Department of Water Resources
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
FEMA	Federal Emergency Management Agency
FID	Fresno Irrigation District
FIRM	Flood Insurance Rate Map
FMFCD	Fresno Metropolitan Flood Control District
FRA	Federal Rail Administration
GIS	Geographic Information System
gpm	gallon(s) per minute
HMF	heavy maintenance facility
HST	high-speed train
IRWMP	Integrated Regional Water Management Plan
KRCD	Kings River Conservation District
kV	kilovolt(s)
MEP	maximum extent practicable
MS4	municipal separate storm sewer systems
NED	National Elevation Dataset

NEPA	National Environmental Policy Act
NFIP	National Flood Insurance Program
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NRCS	National Resource Conservation Service
NWR	National Wildlife Refuge
PCB	polychlorinated biphenyl
ROD	Record of Decision
RTP	Regional Transportation Plan
RWQCB	Regional Water Quality Control Board
SAR	Synthetic Aperture Radar
SDWA	Safe Drinking Water Act
SFHA	special flood hazard area
SR	State Route
SSA	sole-source aquifer
SVF	South Valley Floor
SWMP	Stormwater Management Plan
SWPPP	Stormwater Pollution Prevention Plan
SWRCB	State Water Resources Control Board
TDS	total dissolved solid(s)
TMDL	total maximum daily load
TPSS	traction power supply system
U.S. EPA	U.S. Environmental Protection Agency
U.S.C.	United States Code
UPRR	Union Pacific Railroad
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
WDR	Waste Discharge Requirement
WSS	Web Soil Survey

Section 1.0
Introduction

1.0 Introduction

The California High-Speed Rail Authority (Authority) proposes to construct, operate, and maintain an electric-powered high-speed train (HST) system in California. When completed, the nearly 800-mile train system would provide new passenger rail service to more than 90% of the state's population. More than 200 weekday trains would serve the statewide intercity travel market. The HST would be capable of operating at speeds of up to 220 miles per hour, with state-of-the-art safety, signaling, and automated train control systems. The system would connect and serve the major metropolitan areas of California, extending from San Francisco and Sacramento in the north to San Diego in the south.

In 2005, the Authority and the Federal Railroad Administration (FRA) prepared a Program Environmental Impact Report/Environmental Impact Statement (Statewide Program EIR/EIS) evaluating HST's ability to meet the existing and future capacity demands on California's intercity transportation system (Authority and FRA 2005). This was the first phase of a tiered environmental review process (Tier 1) for the proposed statewide HST System. The Authority and the FRA completed a second Program EIR/EIS in July 2008 to identify a preferred alignment for the Bay Area to Central Valley section (Authority and FRA [2008] 2010).

The Authority and FRA are now undertaking second-tier, project environmental evaluations for sections of the statewide HST System. This Hydrology and Water Quality Technical Report is for the Fresno to Bakersfield Section. The Fresno to Bakersfield Section begins at the proposed Fresno HST station in downtown Fresno and extends east past the proposed Bakersfield HST station in downtown Bakersfield for approximately 1 mile to Union Avenue. Information from this report is summarized in the project EIR/EIS for the Fresno to Bakersfield HST Section and will be part of the administrative record supporting the environmental review of the proposed project.

For the HST System, including the Fresno to Bakersfield Section, the FRA is the lead federal agency for compliance with the National Environmental Policy Act (NEPA) and other federal laws. The Authority is serving as a joint-lead agency under NEPA and is the lead agency for compliance with the California Environmental Quality Act (CEQA). The U.S. Army Corps of Engineers (USACE) is serving as a cooperating agency under NEPA for the Fresno to Bakersfield Section.

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Section 2.0
Project Description

2.0 Project Description

2.1 Project Introduction

The Fresno to Bakersfield Section of the HST project would be approximately 114 miles long, varying in length by only a few miles depending on the route alternatives selected. To comply with the Authority's guidance to use existing transportation corridors when feasible, the Fresno to Bakersfield HST Section would primarily be located adjacent to the existing BNSF Railway right-of-way. Alternative alignments are being considered where engineering constraints require deviation from the existing railroad corridor, and where necessary to avoid environmental impacts.

The Fresno to Bakersfield HST Section would cross both urban and rural lands and include a station in both Fresno and Bakersfield, a potential Kings/Tulare Regional Station in the vicinity of Hanford, a potential heavy maintenance facility (HMF), and power substations along the alignment. The HST alignment would be entirely grade-separated, meaning that crossings with roads, railroads, and other transport facilities would be located at different heights (overpasses or underpasses) so that the HST would not interrupt nor interface with other modes of transport. The HST right-of-way would also be fenced to prohibit public or vehicle access. The project footprint would primarily consist of the train right-of-way, which would include both a northbound and southbound track in an area typically 120 feet wide. Additional right-of-way would be required to accommodate stations, multiple track at stations, maintenance facilities, and power substations.

The Fresno to Bakersfield Section would include at-grade, below-grade, and elevated track segments. The at-grade track would be laid on an earthen rail bed topped with rock ballast approximately 6 feet off the ground; fill and ballast for the rail bed would be obtained from permitted borrow sites and quarries. Below-grade track would be laid in an open or covered trench at a depth that would allow roadway and other grade-level uses above the track. Elevated track segments would span long sections of urban development or aerial roadway structures and consist of steel truss aerial structures with cast-in-place reinforced-concrete columns supporting the box girders and platforms. The height of elevated track sections would depend on the height of existing structures below, and would range from 40 to 80 feet. Columns would be spaced 60 to 120 feet apart.

2.2 Project Alternatives

2.2.1 Alignment Alternatives

This section describes the Fresno to Bakersfield HST Section project alternatives, including the No Project Alternative. The Project EIR/EIS for the Fresno to Bakersfield HST Section examines alternative alignments, stations, and HMF sites within the general BNSF Railway corridor. Discussion of the HST project alternatives begins with a single continuous alignment (the BNSF Alternative) from Fresno to Bakersfield. This alternative most closely aligns with the preferred alignment identified in the Record of Decision (ROD) for the Statewide Program EIR/EIS. Descriptions of the additional eight alternative alignments that deviate from the BNSF Alternative for portions of the route then follow. The alternative alignments that deviate from the BNSF Alternative were selected to avoid environmental, land use, or community issues identified for portions of the BNSF Alternative (Figure 2-1).

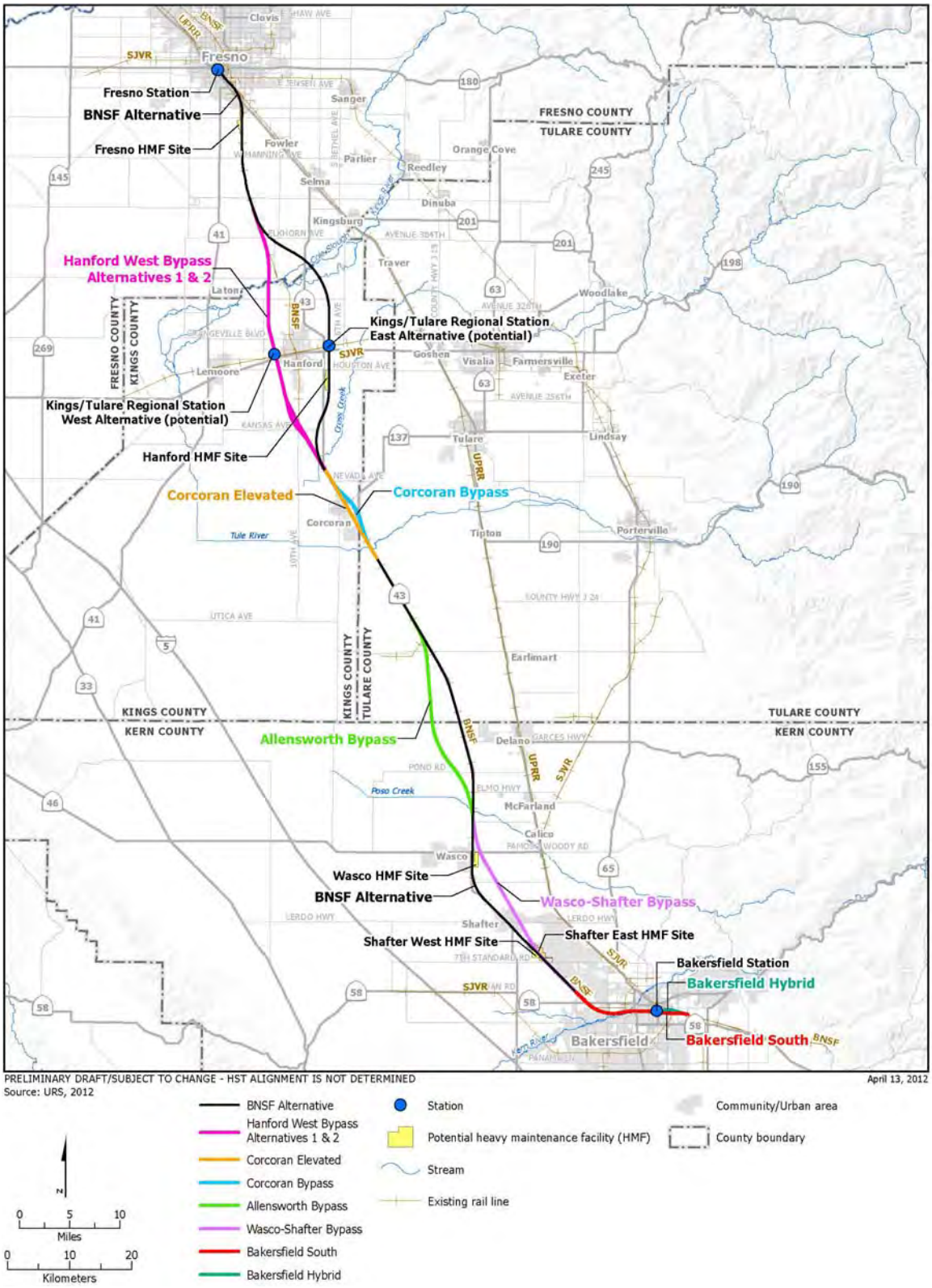


Figure 2-1
Fresno to Bakersfield HST alignments

2.2.1.1 No Project Alternative

Under the No Project Alternative, the HST System would not be built. The No Project Alternative represents the condition of the Fresno to Bakersfield Section as it existed in 2009 (when the Notice of Preparation was issued), and as it would exist without the HST project at the planning horizon (2035). In assessing future conditions, it was assumed that all currently known programmed and funded improvements to the intercity transportation system (highway, rail, and transit), and reasonably foreseeable local development projects (with funding sources identified), would be developed by 2035. The No Project Alternative is based on a review of regional transportation plans (RTPs) for all modes of travel, the State of California Office of Planning and Research CEQAnet Database, the Federal Aviation Administration Air Carrier Activity Information System and Airport Improvement Plan grant data, the State Transportation Improvement Program, airport master plans and interviews with airport officials, intercity passenger rail plans, and city and county general plans and interviews with planning officials.

2.2.1.2 BNSF Alternative

The BNSF Alternative's cross sections include provisions for a 102-foot separation of the HST track centerline from the BNSF Railway track centerline, as well as separations that include swale or berm protection, or an intrusion protection barrier (wall) where the HST tracks are closer. A 102-foot separation between the centerlines of BNSF Railway and HST tracks is provided wherever feasible and appropriate. In urban areas where a 102-foot separation could result in substantial displacement of businesses, homes, and infrastructure, the separation between the BNSF Railway and HST was reduced. The areas with reduced separation require protection to prevent encroachment on the HST right-of-way in the event of a freight rail derailment. The use of a swale, berm, or wall protection would depend on the separation distance.

The BNSF Alternative would extend approximately 114 miles from Fresno to Bakersfield and would lie adjacent to the BNSF Railway route to the extent feasible (Figure 2-1). Minor deviations from the BNSF Railway corridor would be necessary to accommodate engineering constraints, namely wider curves necessary to accommodate the HST (as compared with the existing lower-speed freight line track alignment). The largest of these deviations occurs between approximately Elk Avenue in Fresno County and Nevada Avenue in Kings County. This segment of the BNSF Alternative would depart from BNSF Railway corridor and instead curve to the east on the northern side of the Kings River and away from Hanford, and would rejoin the BNSF Railway corridor north of Corcoran.

Although the majority of the alignment would be at-grade, the BNSF Alternative would include aerial structures in all of the four counties through which it travels. In Fresno County, an aerial structure would carry the alignment over Golden State Boulevard and SR 99, and a second would cross over the BNSF Railway tracks in the vicinity of East Conejo Avenue. The alignment would be at-grade with bridges where it crosses Cole Slough and the Kings River into Kings County.

In Kings County, the BNSF Alternative would be elevated east of Hanford where the alignment would pass over the San Joaquin Valley Railroad (SJVR) and SR 198. The alignment would also be elevated over Cross Creek, and again in the city of Corcoran to avoid a BNSF Railway spur and agricultural facilities located at the southern end of the city. In Tulare County, the BNSF Alternative would be elevated at the Tule River crossing and over Deer Creek and the Stoil railroad spur that runs west from the BNSF Railway mainline. In Kern County, the BNSF Alternative would be elevated through the cities of Wasco, Shafter, and Bakersfield. The BNSF Alternative would be at-grade through the rural areas between these cities.

The BNSF Alternative would provide wildlife crossing opportunities by means of a variety of engineered structures. Dedicated wildlife crossing structures would be provided from

approximately Cross Creek (Kings County) south to Poso Creek (Kern County) in at-grade portions of the railroad embankment at approximately 0.3-mile intervals. In addition to those structures, wildlife crossing opportunities would be available at elevated portions of the alignment, at bridges over riparian corridors, at road overcrossings and undercrossings, and at drainage facilities (i.e., large-diameter [60 to 120 inches] culverts and paired 30-inch culverts). 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.

The preliminary wildlife crossing structure design consists of a modified culvert in the embankment that would support the HST tracks. The typical culvert would be 73 feet long from end to end (crossing structure distance), would span a width of approximately 10 feet (crossing structure width), and would provide 3 feet of vertical clearance (crossing structure height). Additional wildlife crossing structure designs could include circular or elliptical pipe culverts, and larger (longer) culverts with crossing structure distances of up to 100 feet. The design of the wildlife crossing structures may change depending on site-specific conditions and engineering considerations.

2.2.1.3 Hanford West Bypass 1 Alternative

The Hanford West Bypass 1 Alternative would parallel the BNSF Alternative from East Kamm Avenue to approximately East Elkhorn Avenue in Fresno County. At East Conejo Avenue where the BNSF Alternative crosses to the eastern side of the BNSF Railway tracks to pass the city of Hanford to the east, the Hanford West Bypass 1 Alternative continues south on the western side of the BNSF Railway tracks. The Hanford West Bypass 1 would diverge from the BNSF Railway corridor just south of East Elkhorn Avenue and ascend onto an elevated structure just south of East Harlan Avenue, crossing over the Kings River complex and Murphy Slough, and passing the community of Laton to the west. The Hanford West Bypass 1 Alternative would return to grade just north of Dover Avenue. The alignment would continue at-grade and would travel between the community of Armona to the west and the city of Hanford to the east on a southeasterly route toward the BNSF Railway corridor. In order to avoid a large dairy located at the intersection of Kent and 11th avenues, the Hanford West Bypass 1 Alternative must travel to its west and deviate from the BNSF Railway corridor in the area of Kansas Avenue. The alignment would pass to the west of a large complex of BNSF Railway serviced grain silos and loading bays before it rejoins the BNSF Railway corridor adjacent to its western side at about Lansing Avenue. The alignment would continue on the western side of the BNSF Railway corridor and ascend onto another elevated structure, traveling over Cross Creek and special aquatic features that exist north of Corcoran. This alignment would return to grade just north of Nevada Avenue and would connect to the BNSF Alternative traveling through Corcoran at-grade, maintaining an alignment on the western side of the BNSF Railway corridor. The total length of the Hanford West Bypass 1 Alternative would be approximately 28 miles.

The Hanford West Bypass 1 Alternative includes a design option where the alignment would be below-grade between Grangeville Boulevard and Houston Avenue. The alignment would travel below-grade in an open cut with side slopes as it transitions to a retained-cut profile. As the alignment transitions back to grade just north of Houston Avenue, the open-cut profile would be used once more. The alignment would cross SR 198 and several local roads. South Peach Avenue, East Clarkson Avenue, East Barrett Avenue, Elder Avenue, and South Tenth Avenue would be closed at the HST right-of-way, while the other roads would be realigned and/or grade-separated from the HST with overcrossings/undercrossings. Grade separations at Grangeville Boulevard, Thirteenth Avenue, and West Lacey Boulevard would be determined based on the alignment design option selected (at-grade or below-grade).

The potential Kings/Tulare Regional Station–West Alternative would be located along this alignment, east of Thirteenth Avenue between Lacey Boulevard and the SJVR railroad spur. This potential station includes an at-grade and below-grade design option as well.

2.2.1.4 Hanford West Bypass 2 Alternative

The Hanford West Bypass 2 Alternative would be the same as the Hanford West Bypass 1 Alternative from East Kamm Avenue to just north of Jackson Avenue. The Hanford West Bypass 2 Alternative would then curve away from the Hanford West Bypass 1 Alternative to travel to the east of the dairy located at the intersection of Kent and 11th avenues toward the BNSF Railway corridor, approximately 0.3 mile east of the Hanford West Bypass 1 route. The Hanford West Bypass 2 Alternative would ascend over Kent Avenue and then cross over the BNSF Railway right-of-way to the northeast of the large complex of grain silos and loading bays located north of Kansas Avenue. The alignment would remain elevated for approximately 1.5 miles and parallel the BNSF Railway to the east, then cross over Kansas Avenue. The alignment would return to grade north of Lansing Avenue and continue along the BNSF Railway corridor on its eastern side. Similar to the Hanford West Bypass 1 Alternative, the Hanford West Bypass 2 Alternative would travel over Cross Creek and the special aquatic features located north of Corcoran and return to grade north of Nevada Avenue; however, the Hanford West Bypass 2 would be located on the eastern side of the BNSF Railway tracks in order to connect to either of the two Corcoran alternatives that would travel on the eastern side of the BNSF Railway corridor, the Corcoran Elevated Alternative or the Corcoran Bypass Alternative, described below. Like the Hanford West Bypass 1 Alternative, the total length of the Hanford West Bypass 2 Alternative would be approximately 28 miles.

The Hanford West Bypass 2 Alternative includes the same below-grade design option between Grangeville Boulevard and Houston Avenue as the Hanford West Bypass 1 Alternative, as well as either the at-grade or below-grade potential Kings/Tulare Regional Station–West Alternative. Similar to the Hanford West Bypass 1 Alternative, Hanford West Bypass 2 would cross SR 198 and several local roads. Road closures would be the same as those for the Hanford West Bypass 1, and roadway modifications at Grangeville Boulevard, Thirteenth Avenue, and West Lacey Boulevard would depend on the alignment design option selected.

2.2.1.5 Corcoran Elevated Alternative

The Corcoran Elevated Alternative would be the same as the corresponding section of the BNSF Alternative from approximately Nevada Avenue to Avenue 136, except that it would pass through the city of Corcoran on the eastern side of the BNSF Railway right-of-way on an aerial structure. The aerial structure would begin at Niles Avenue and return to grade south of Fourth Avenue. The total length of the Corcoran Elevated Alternative would be approximately 10 miles. Dedicated wildlife crossing structures would be provided from approximately Cross Creek south to Avenue 136 in at-grade portions of the railroad embankment at intervals of approximately 0.3 mile. Dedicated wildlife crossing structures would also be placed between 100 and 500 feet to the north and south of both the Cross Creek and Tule River crossings.

This alternative alignment would pass over several local roads on an aerial structure. Santa Fe Avenue and Avenue 136 would be closed at the HST right-of-way.

2.2.1.6 Corcoran Bypass Alternative

The Corcoran Bypass Alternative would diverge from the BNSF Alternative at Nevada Avenue and swing east of Corcoran, rejoining the BNSF Railway route at Avenue 136. The total length of the Corcoran Bypass would be approximately 10 miles. Similar to the corresponding section of the BNSF Alternative, most of the Corcoran Bypass Alternative would be at-grade. However, one elevated structure would carry the HST over SR 43, the BNSF Railway, and the Tule River.

Dedicated wildlife crossing structures would be provided from approximately Cross Creek south to Avenue 136 in at-grade portions of the railroad embankment at intervals of approximately 0.3 mile. Dedicated wildlife crossing structures would also be placed between 100 and 500 feet to the north and south of each of the Cross Creek and Tule River crossings.

This alternative alignment would cross SR 43, Whitley Avenue/SR 137, and several local roads. SR 43, Waukena Avenue, and Whitley Avenue would be grade-separated from the HST with an overcrossing/undercrossing; other roads would be closed at the HST right-of-way.

2.2.1.7 Allensworth Bypass Alternative

The Allensworth Bypass Alternative would pass west of the BNSF Alternative, avoiding Allensworth Ecological Reserve and the Allensworth State Historic Park. This alignment was refined over the course of environmental studies to reduce impacts to wetlands and orchards. The total length of the Allensworth Bypass Alternative would be approximately 21 miles, beginning at Avenue 84 and rejoining the BNSF Alternative at Elmo Highway. The Allensworth Bypass Alternative would be constructed on an elevated structure only where the alignment crosses Deer Creek and the Stoil railroad spur. The majority of the alignment would pass through Tulare County at-grade. Dedicated wildlife crossing structures would be provided from approximately Avenue 84 to Poso Creek at intervals of approximately 0.3 mile. Dedicated wildlife crossing structures would also be placed between 100 and 500 feet to the north and south of both the Deer Creek and Poso Creek crossings.

The Allensworth Bypass would cross several roads including County Road J22, Avenue 24, Garces Highway, Woollomes Avenue, Magnolia Avenue, Pond Road, and Elmo Highway. Avenue 24, Woollomes Avenue, and Elmo Highway would be closed at the HST right-of-way, while the other roads would be realigned and/or grade-separated from the HST with overcrossings.

2.2.1.8 Wasco-Shafter Bypass Alternative

The Wasco-Shafter Bypass Alternative would diverge from the BNSF Alternative between Taussig Avenue and Zachary Avenue, crossing over to the eastern side of the BNSF Railway tracks and bypassing Wasco and Shafter to the east. The Wasco-Shafter Bypass Alternative would be at-grade except where it travels over 7th Standard Road and the BNSF Railway to rejoin the BNSF Alternative. The total length of the Wasco-Shafter Bypass Alternative would be approximately 21 miles.

The Wasco-Shafter Bypass was refined to avoid the Occidental Petroleum tank farm as well as a historic property potentially eligible for listing on the National Register of Historic Places. The Wasco-Shafter Bypass would cross SR 43, SR 46, East Lerdo Highway, and several local roads. Roads, including SR 46, Kimberlina Road, Shafter Avenue, Beech Avenue, Cherry Avenue, and Kratzmeyer Road, would be grade-separated from the HST with overcrossings/undercrossings; other roads would be closed at the HST right-of-way.

2.2.1.9 Bakersfield South Alternative

From the Rosedale Highway (SR 58) in Bakersfield, the Bakersfield South Alternative would parallel the BNSF Alternative at varying distances to the north. At Chester Avenue, the Bakersfield South Alternative would curve south and run parallel to California Avenue. As with the BNSF Alternative, the Bakersfield South Alternative would begin at-grade and become elevated starting at Country Breeze Place through Bakersfield to its terminus at Oswell Street. Dedicated wildlife crossing structures would not be required because this alternative would be elevated to the north and south of the Kern River.

The Bakersfield South Alternative would be approximately 12 miles long and would cross many of the same roads as the BNSF Alternative. This alternative includes the Bakersfield Station–South Alternative.

2.2.1.10 Bakersfield Hybrid Alternative

From Rosedale Highway (SR 58) in Bakersfield, the Bakersfield Hybrid Alternative would follow the Bakersfield South Alternative and parallel the BNSF Alternative at varying distances to the north. At approximately A Street, the Bakersfield Hybrid Alternative would diverge from the Bakersfield South Alternative, cross over Chester Avenue and the BNSF right-of-way in a southeasterly direction, then curve back to the northeast to parallel the BNSF Railway tracks towards Kern Junction. After crossing Truxtun Avenue, the alignment would curve to the southeast to parallel the UPRR tracks to its terminus at Oswell Street. As with the BNSF and Bakersfield South alternatives, the Bakersfield Hybrid Alternative would begin at-grade and become elevated starting at Country Breeze Place through Bakersfield to Oswell Street. Dedicated wildlife crossing structures would not be required because this alternative would be elevated to the north and south of the Kern River.

The Bakersfield Hybrid Alternative would be approximately 12 miles long and would cross many of the same roads as the BNSF and Bakersfield South alternatives. This alternative includes the Bakersfield Station–Hybrid Alternative.

2.2.2 Station Alternatives

The Fresno to Bakersfield HST Section would include a new station in Fresno and a new station in Bakersfield. A potential third station, the Kings/Tulare Regional Station, is under consideration.

Stations would be designed to address the purpose of the HST, particularly to allow for intercity travel and connection to local transit, airports, and highways. Stations would include the station platforms, a station building, and associated access structure, as well as lengths of bypass tracks to accommodate local and express service at the stations. All stations would contain the following elements:

- Passenger boarding and alighting 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) and “kiss-and-ride.”[1]
- Motorcycle/scooter parking.
- Bicycle parking.
- Waiting areas and queuing space for taxis and shuttle buses.
- Pedestrian walkway connections.

2.2.2.1 Fresno Station Alternatives

Two alternative sites are under consideration for the Fresno Station.

<u>Fresno Station–Mariposa Alternative</u>

The Fresno Station–Mariposa Alternative would be located in Downtown Fresno, less than 0.5 mile east of SR 99 on the BNSF Alternative. The station would be centered on Mariposa Street and bordered by Fresno Street on the north, Tulare Street on the south, H Street on the east,

[1] “Kiss-and-ride” refers to the station area where riders may be dropped off or picked up before or after riding the HST.

and G Street on the west. The station building would be approximately 75,000 square feet, with a maximum height of approximately 64 feet.

The two-level station would be at-grade; with passenger access provided both east and west of the HST guideway and the UPRR tracks, which would run parallel to one another next to the station. The first level would contain the public concourse, passenger service areas, and station and operation offices. The second level would include a mezzanine, a pedestrian overcrossing above the HST guideway and the UPRR tracks, and an additional public concourse area. Entrances would be located at both G and H streets. A conceptual site plan of the Fresno Station–Mariposa Alternative is provided in Figure 2-2.

The majority of station facilities would be east of the UPRR tracks. The station and associated facilities would occupy approximately 20.5 acres, including 13 acres dedicated to the station, short-term parking, and kiss-and-ride accommodations. A new intermodal facility, not a part of this proposed undertaking, would be located on the parcel bordered by Fresno Street to the north, Mariposa Street to the south, Broadway Street to the east, and H Street to the west (designated "Intermodal Transit Center" in Figure 2-2). Among other uses, the intermodal facility would accommodate the Greyhound facilities and services that would be relocated from the northwestern corner of Tulare and H streets.

The site proposal includes the potential for up to three parking structures that would occupy a total of approximately 5.5 acres. Two of the three potential parking structures would each sit on 2 acres, and each would have a capacity of approximately 1,500 cars. The third parking structure would be slightly smaller in footprint (1.5 acres), with five levels and a capacity of approximately 1,100 cars. An additional 2-acre surface parking lot would provide approximately 300 parking spaces.

Under this alternative, the historic Southern Pacific Railroad depot and associated Pullman Sheds would remain intact. While these structures could be used for station-related purposes, they are assumed not to be functionally required for the HST project, and are therefore not proposed to be physically altered as part of the project. The Mariposa station building footprint has been configured to preserve views of the historic railroad depot and associated sheds.

Fresno Station–Kern Alternative

The Fresno Station–Kern Alternative would be similarly situated in Downtown Fresno and would be located on the BNSF Alternative, centered on Kern Street between Tulare Street and Inyo Street (Figure 2-3). This station would include the same components as the Fresno Station–Mariposa Alternative, but under this alternative, no station facilities would be located adjacent to the historic Southern Pacific Railroad depot and relocation of existing Greyhound facilities would not be required.

The station building would be approximately 75,000 square feet, with a maximum height of approximately 64 feet. The station building would have two levels and house the same facilities as the Fresno Station–Mariposa Alternative (UPRR tracks, HST tracks, mezzanine, and station office). The approximately 18.5-acre site would include 13 acres dedicated to the station, bus transit center, short-term parking, and kiss-and-ride accommodations.

Two of the three potential parking structures would each sit on 2 acres, and each would have a capacity of approximately 1,500 cars. The third structure would be slightly smaller in footprint (1.5 acres) and have a capacity of approximately 1,100 cars. Surface parking lots would provide approximately 600 additional parking spaces. Like the Fresno Station–Mariposa Alternative, the majority of station facilities under the Kern Alternative would be sited east of the HST tracks.

2.2.2.2 Kings/Tulare Regional Station

Two alternative sites are under consideration for the potential Kings/Tulare Regional Station.

Kings/Tulare Regional Station–East Alternative

The potential Kings/Tulare Regional Station would be located east of SR 43 (Avenue 8) and north of the SJVR on the BNSF Alternative (Figure 2-4). The station building would be approximately 40,000 square feet with a maximum height of approximately 75 feet. The entire site would be approximately 25 acres, including 8 acres designated for the station, bus transit center, short-term parking, and kiss-and-ride. An additional approximately 17.25 acres would support a surface parking lot with approximately 2,280 spaces.

Kings/Tulare Regional Station–West Alternative

The potential Kings/Tulare Regional Station–West Alternative would be located east of Thirteenth Avenue and north of the SJVR on the Hanford West Bypass 1 and 2 alternatives. The station would be located either at-grade or below-grade depending on which Hanford West Bypass alignment design option is chosen.

The at-grade Kings/Tulare Regional Station–West Alternative would include a station building of approximately 100,000 square feet with a maximum height of approximately 36 feet. The entire site would be approximately 48 acres, including 6 acres designated for the station, bus bays, short-term parking, and kiss-and-ride areas. Approximately 5 acres would support a surface parking lot with approximately 700 spaces. An additional 3.5 acres would support two parking structures with a combined parking capacity of 2,100 spaces (Figure 2-5).

The below-grade Kings/Tulare Regional Station–West Alternative would include a station building of approximately the same size and height. The below-grade station site would include the same components as the at-grade station option on the same number of acres; however, the station platform would be located below-grade instead of at ground level. Approximately 4 acres would support a surface parking lot with approximately 600 spaces and an additional 4 acres would support two parking structures with a combined parking capacity of 2,200 spaces (Figure 2-6).

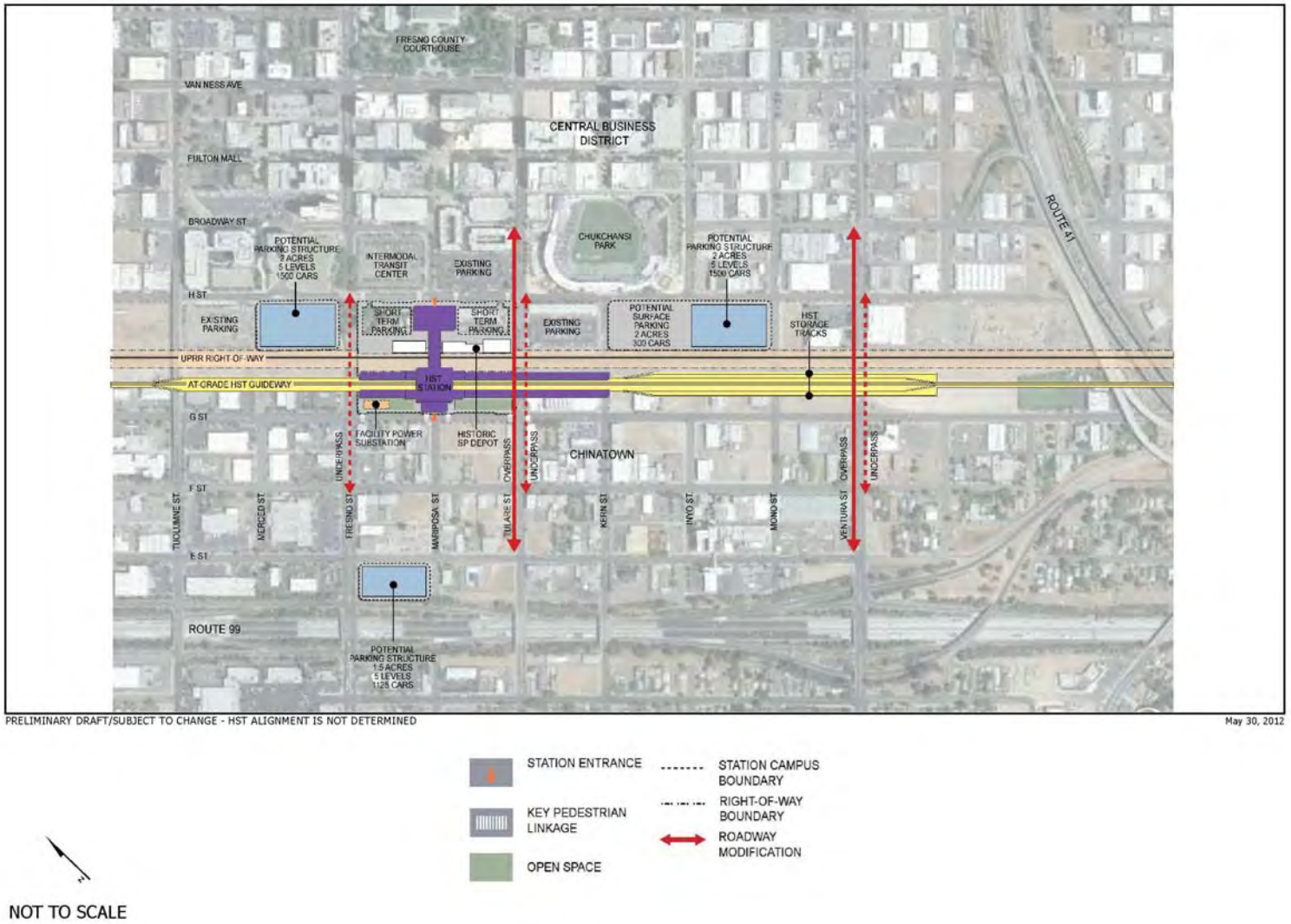
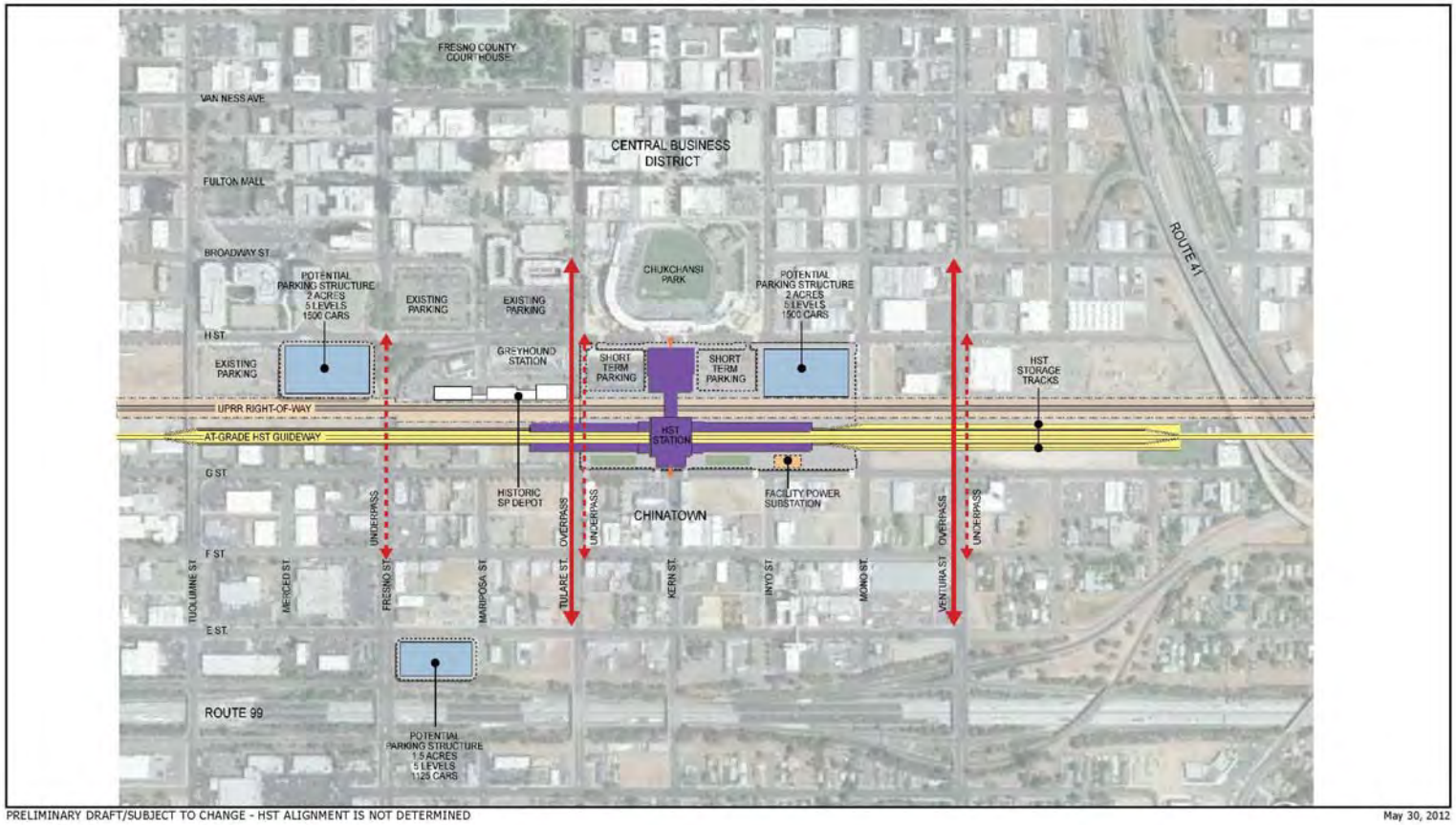


Figure 2-2
Fresno Station–Mariposa Alternative



PRELIMINARY DRAFT/SUBJECT TO CHANGE - HST ALIGNMENT IS NOT DETERMINED

May 30, 2012

STATION ENTRANCE
KEY PEDESTRIAN LINKAGE
OPEN SPACE
STATION CAMPUS BOUNDARY
RIGHT-OF-WAY BOUNDARY
ROADWAY MODIFICATION

NOT TO SCALE

Figure 2-3
Fresno Station–Kern Alternative

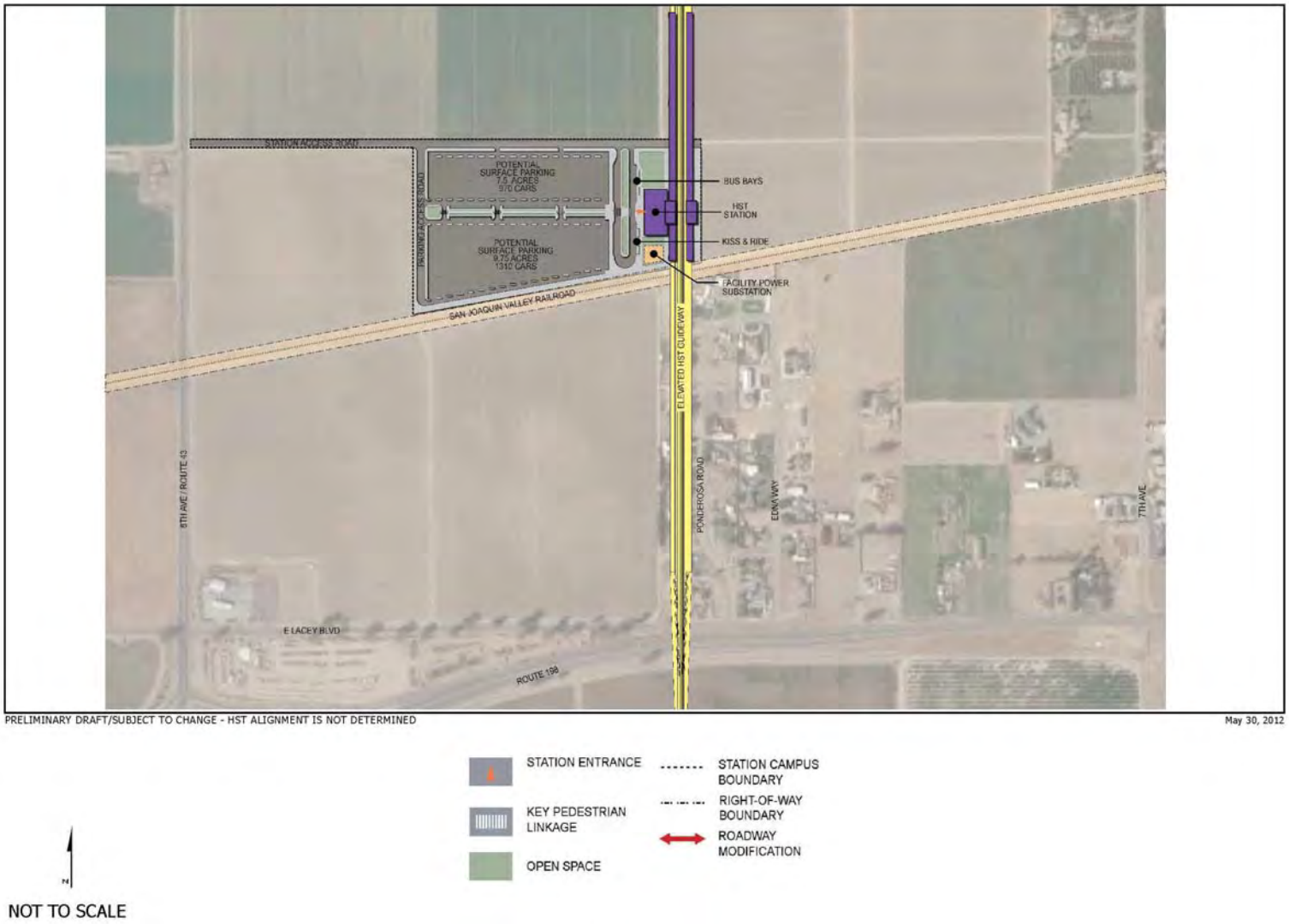


Figure 2-4
Kings/Tulare Regional Station–East Alternative

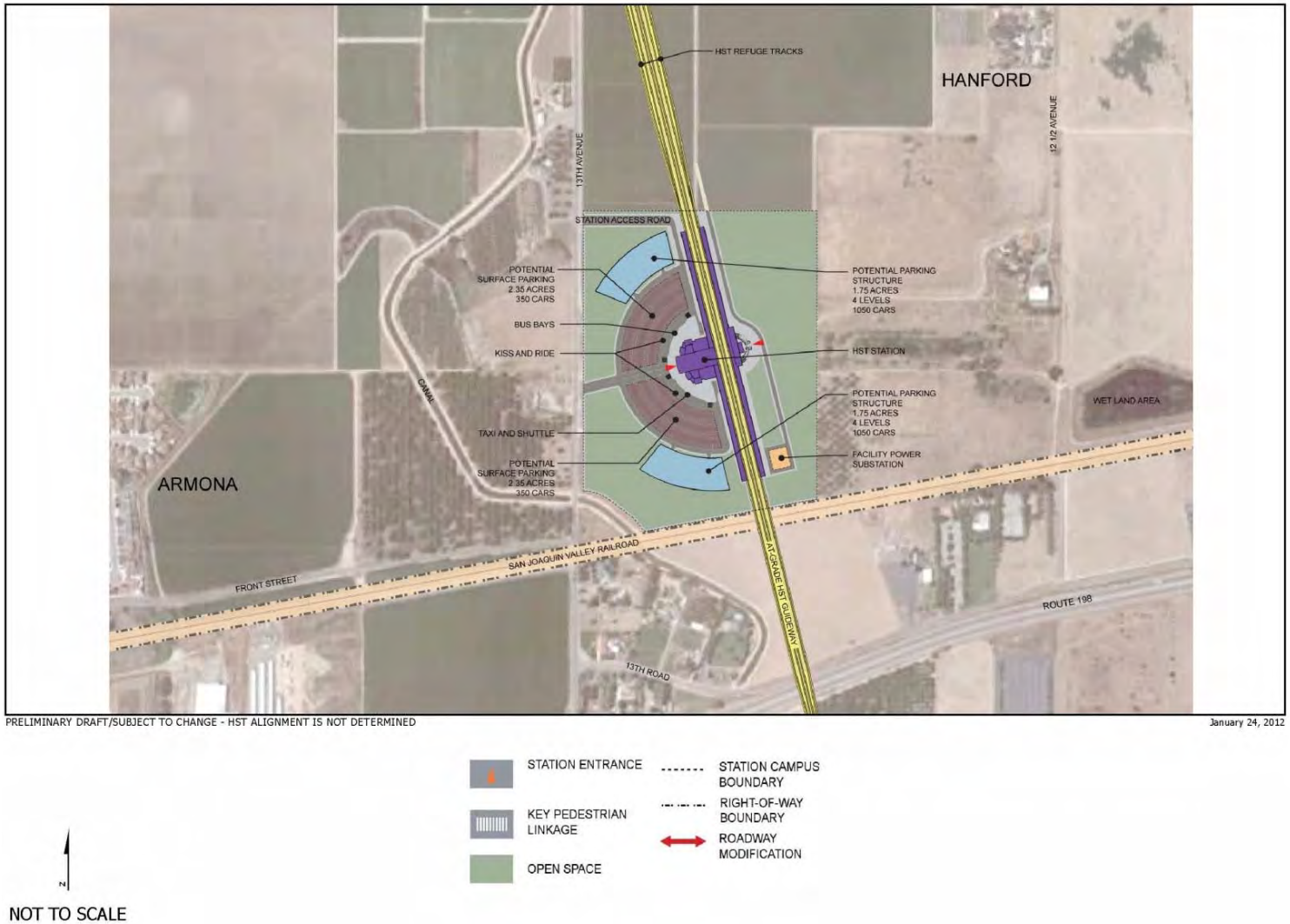


Figure 2-5
Kings/Tulare Regional Station–West Alternative (at-grade option)

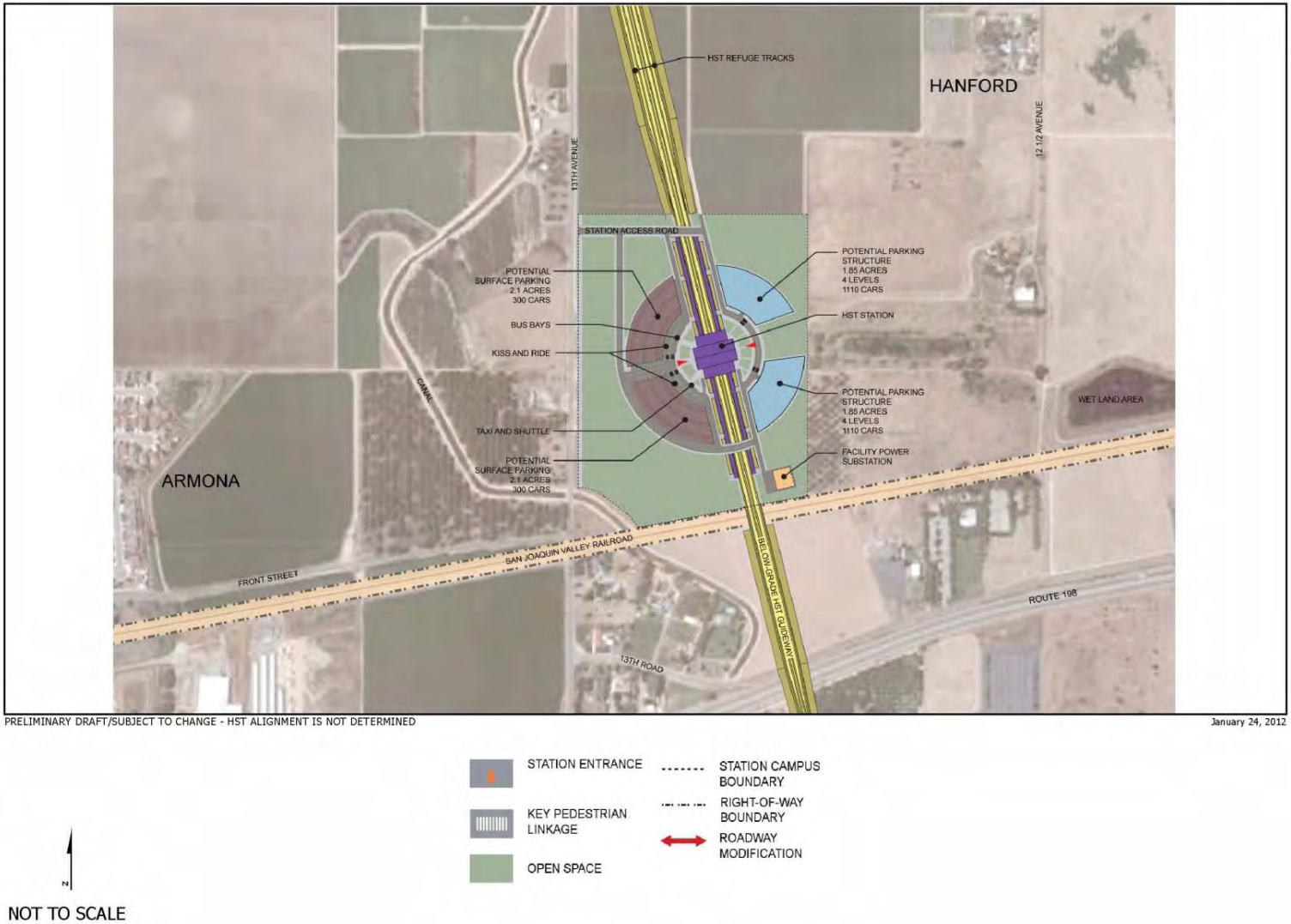


Figure 2-6
Kings/Tulare Regional Station–West Alternative (below-grade option)

2.2.2.3 Bakersfield Station Alternatives

Three options are under consideration for the Bakersfield Station.

Bakersfield Station–North Alternative

The Bakersfield Station–North Alternative would be located at the corner of Truxtun and Union Avenue/SR 204 along the BNSF Alternative (Figure 2-7). The three-level station building would be 52,000 square feet, with a maximum height of approximately 95 feet. The first level would house station operation offices and would also accommodate trains running along the BNSF Railway line. The second level would include the mezzanine; the HST platforms and guideway would pass through the third level. Under this alternative, the station building would be located at the western end of the parcel footprint. Two new boulevards would be constructed to access the station and the supporting facilities.

The 19-acre site would designate 11.5 acres for the station, bus transit center, short-term parking, and kiss-and-ride. An additional 7.5 acres would house two parking structures that together would accommodate approximately 4,500 cars. The bus transit center and the smaller of the two parking structures (2.5 acres) would be located north of the HST tracks. The BNSF Railway line would run through the station at-grade, with the HST alignment running on an elevated guideway.

Bakersfield Station–South Alternative

The Bakersfield Station–South Alternative would be would be similarly located in downtown Bakersfield, but situated on the Bakersfield South Alternative along Union and California avenues, just south of the BNSF Railway right-of-way (Figure 2-8). The two-level station building would be 51,000 square feet, with a maximum height of approximately 95 feet. The first floor would house the concourse, and the platforms and the guideway would be on the second floor. Access to the site would be from two new boulevards, one branching off from California Avenue and the other from Union Avenue.

The entire site would be 20 acres, with 15 acres designated for the station, bus transit center, short-term parking, and kiss-and-ride. An additional 5 acres would support one six-level parking structure with a capacity of approximately 4,500 cars. Unlike the Bakersfield Station–North Alternative, this station site would be located entirely south of the BNSF Railway right-of-way.

Bakersfield Station–Hybrid Alternative

The Bakersfield Station–Hybrid Alternative would be in the same area as the North and South Station alternatives, and located at the corner of Truxtun and Union Avenue/SR 204 on the Bakersfield Hybrid Alternative (Figure 2-9). The station design includes an approximately 57,000 square-foot main station building and an approximately 5,500 square-foot entry concourse located north of the BNSF Railway right-of-way. The station building would have two levels with a maximum height of approximately 95 feet. The first floor would house the concourse, and the platforms and guideway would be on the second floor. Additionally, a pedestrian overcrossing would connect the main station building to the north entry concourse across the BNSF right-of-way.

The entire site would be approximately 24 acres, with 15 acres designated for the station, bus transit center, short-term parking, and kiss-and-ride areas. Approximately 4.5 of the 24 acres would support three parking structures with a total capacity of approximately 4,500 cars. Each parking structure would be seven levels; one with a planned capacity of 1,750 cars, another with a capacity of 1,315 cars, and the third with a planned capacity of 1,435 cars. An additional 460 parking spaces would be provided in surface lots covering a total of approximately 4.5 acres of

the station site. Access to the station site would be from Truxtun and Union avenues, as well as from Hayden Court. Under this alternative, the BNSF Railway track runs through the station site, and the main station building and majority of station facilities would be sited south of the BNSF Railway right-of-way.

2.2.3 Heavy Maintenance Facility (HMF)

One HST heavy vehicle maintenance and layover facility would be sited along either the Merced to Fresno or Fresno to Bakersfield HST section. Before the start-up of initial operations, the HMF would support the assembly, testing, commissioning, and acceptance of high-speed rolling stock. During regular operations, the HMF would provide maintenance and repair functions, activation of new rolling stock, and train storage. The HMF concept plan indicates that the site would encompass approximately 154 acres to accommodate shops, tracks, parking, administration, roadways, power substation, and storage areas. The HMF would include tracks that allow trains to enter and leave under their own electric power or under tow. The HMF would also have management, administrative, and employee support facilities. Up to 1,500 employees could work at the HMF during any 24-hour period.

The Authority has determined that one HMF would be located between Merced and Bakersfield; however, the specific location has not yet been finalized. The property boundaries for each HMF site would be larger than the acreage needed for the actual facility because of the unique site characteristics and constraints of each location. Five HMF sites are under consideration in the Fresno to Bakersfield Section (Figure 2-1):

- The Fresno Works–Fresno HMF site lies within the southern limits of the city of Fresno and county of Fresno next to the BNSF Railway right-of-way between SR 99 and Adams Avenue. Up to 590 acres are available for the facility at this site.
- The Kings County–Hanford HMF site lies southeast of the city of Hanford, adjacent to and east of SR 43, between Houston and Idaho avenues. Up to 510 acres are available at the site.
- The Kern Council of Governments–Wasco HMF site lies directly east of Wasco between SR 46 and Filburn Street. Up to 420 acres are available for the facility at this site.
- The Kern Council of Governments–Shafter East HMF site lies in the city of Shafter between Burbank Street and 7th Standard Road to the east of the BNSF Railway right-of-way. This site has up to 490 acres available for the facility.
- The Kern Council of Governments–Shafter West HMF site lies in the city of Shafter between Burbank Street and 7th Standard Road to the west of the BNSF Railway right-of-way. This site has up to 480 acres available for the facility.

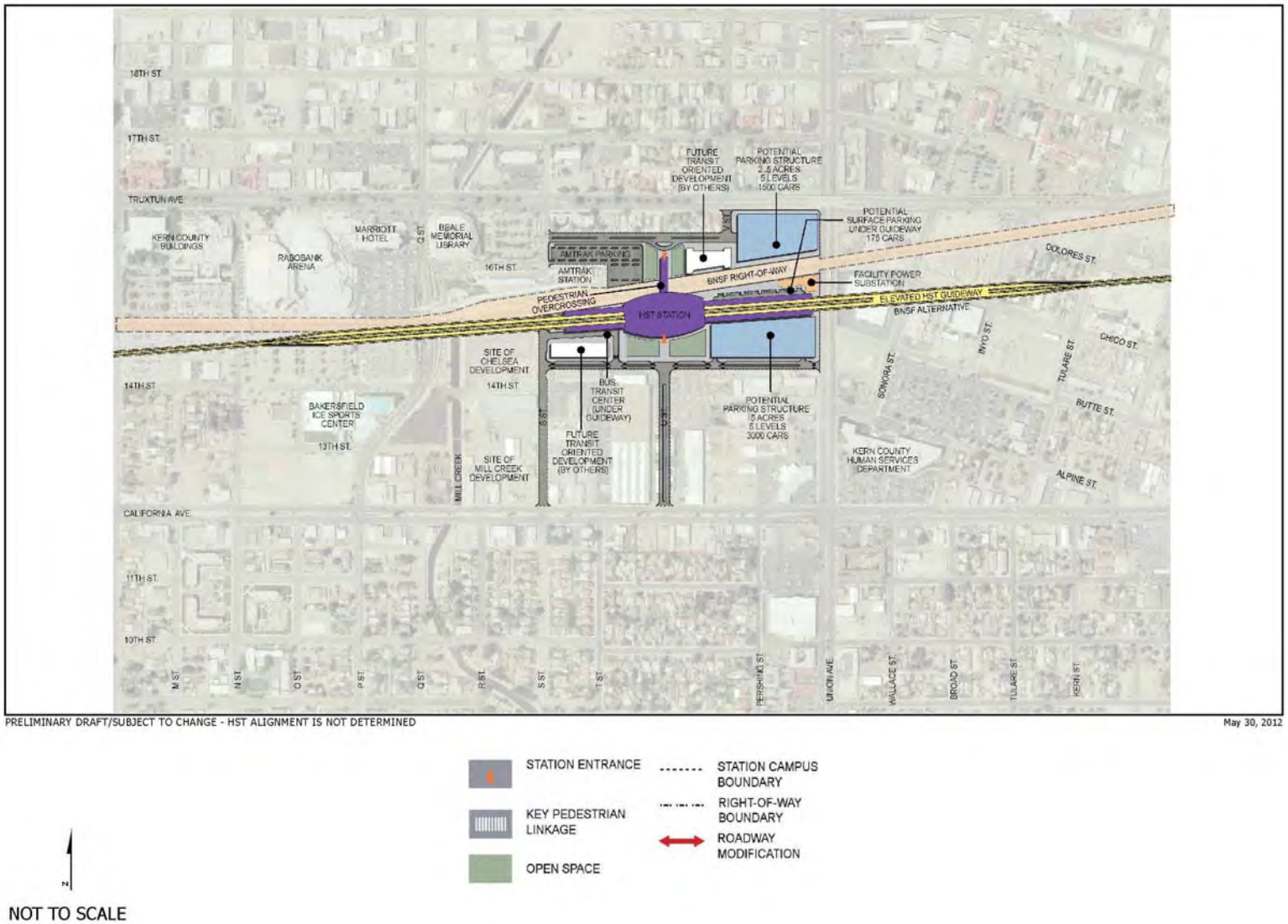
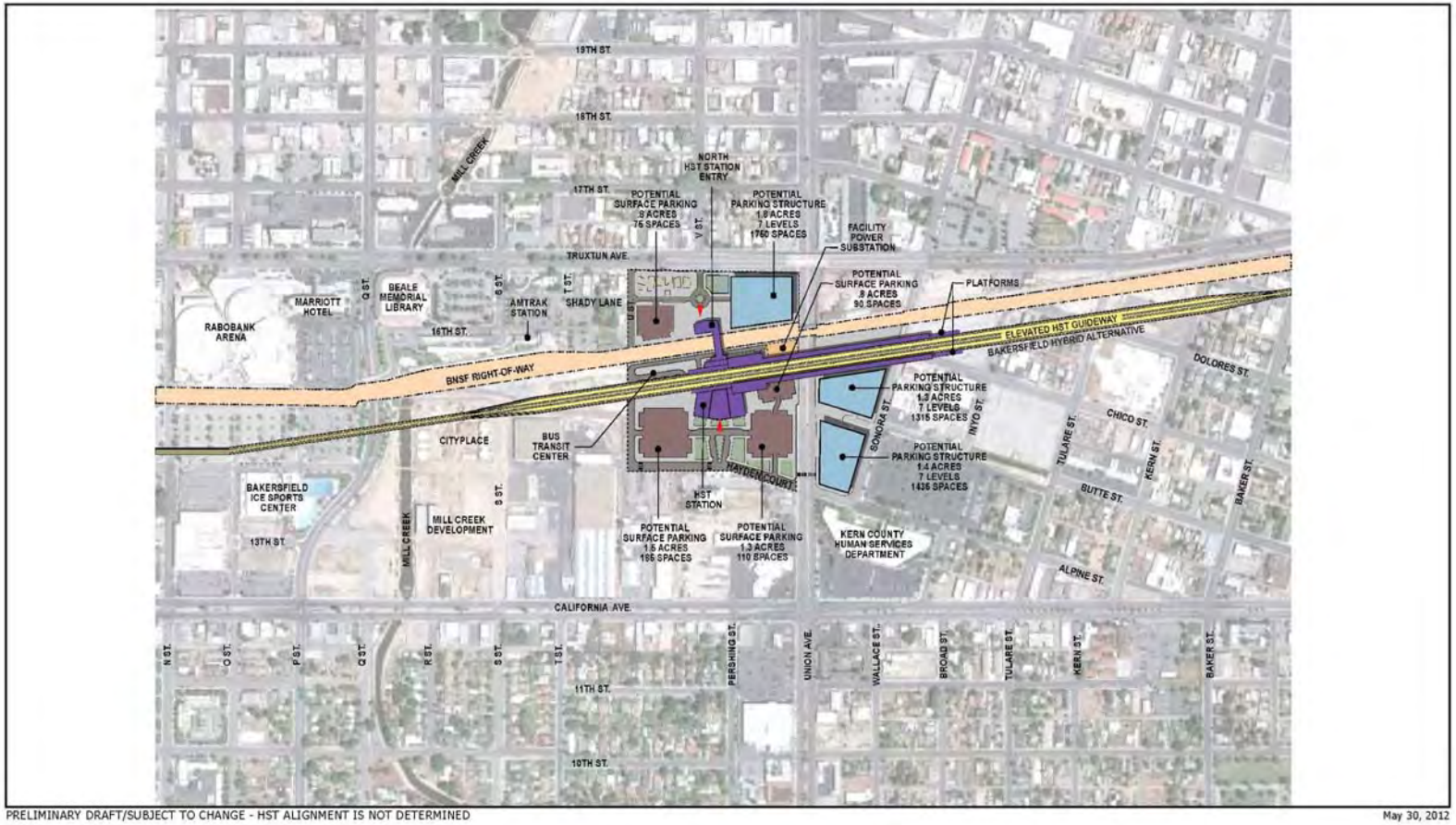


Figure 2-7
Bakersfield Station–North Alternative

Figure 2-8
Bakersfield Station–South Alternative



PRELIMINARY DRAFT/SUBJECT TO CHANGE - HST ALIGNMENT IS NOT DETERMINED

May 30, 2012

STATION ENTRANCE

KEY PEDESTRIAN LINKAGE

OPEN SPACE

STATION CAMPUS BOUNDARY

RIGHT-OF-WAY BOUNDARY

ROADWAY MODIFICATION

NOT TO SCALE

Figure 2-9
Bakersfield Station–Hybrid Alternative

2.3 Power

Power for the HST System would be drawn from California's electricity grid and distributed to the trains via an overhead contact system. The project would not include the construction of a separate power source, although it would include the extension of power lines to a series of power substations positioned along the HST corridor. The transformation and distribution of electricity would occur in three types of stations:

- Traction power substations (TPSSs) transform high-voltage electricity supplied by public utilities to the train operating voltage. TPSSs would be sited adjacent to existing utility transmission lines and the HST right-of-way, and would be located approximately every 30 miles along the route. Each TPSS would be 200 feet by 160 feet.
- Switching stations connect and balance the electrical load between tracks, and switch power on or off to tracks in the event of a power outage or emergency. Switching stations would be located midway between, and approximately 15 miles from, the nearest TPSS. Each switching station would be 120 feet by 80 feet and be located adjacent to the HST right-of-way.
- Paralleling stations, or autotransformer stations, provide voltage stabilization and equalize current flow. Paralleling stations would be located every 5 miles between the TPSSs and the switching stations. Each paralleling station would be 100 feet by 80 feet and located adjacent to the HST right-of-way.

2.4 Project Construction

The construction plan developed by the Authority and described below would maintain eligibility for eligibility for federal American Recovery and Reinvestment Act (ARRA) funding. For the Fresno to Bakersfield Section, specific construction elements would include at-grade, below-grade, and elevated track, track work, grade crossings, and installation of a positive train control system. At-grade track sections would be built using conventional railroad construction techniques. A typical sequence includes clearing, grubbing, grading, and compacting the rail bed; applying crushed rock ballast; laying track; and installing electrical and communications systems.

The precast segmental construction method is proposed for elevated track sections. In this construction method, large concrete bridge segments would be mass-produced at an onsite temporary casting yard. Precast segments would then be transported atop the already completed portions of the elevated track and installed using a special gantry crane positioned on the aerial structure. Although the precast segmental method is the favored technique for aerial structure construction, other methods may be used, including cast-in-place, box girder, or precast span-by-span techniques.

Preconstruction activities would be conducted during final design and include geotechnical investigations, identification of staging areas, initiation of site preparation and demolition, relocation of utilities, and implementation of temporary, long-term, and permanent road closures. Additional studies and investigations to develop construction requirements and worksite traffic control plans would be conducted as needed.

Major construction activities for the Fresno to Bakersfield Section would include earthwork and excavation support systems construction, bridge and aerial structure construction, railroad systems construction (including trackwork, traction electrification, signaling, and communications), and station construction. During peak construction periods, work is envisioned to be underway at several locations along the route, with overlapping construction of various

project elements. Working hours and workers present at any time will vary depending on the activities being performed.

The Authority intends to build the project using sustainable methods that:

- Minimize the use of nonrenewable resources.
- Minimize the impacts on the natural environment.
- Protect environmental diversity.
- Emphasize the use of renewable resources in a sustainable manner.

The approximate schedule for construction is provided in Table 2-1.

Table 2-1
Approximate Construction Schedule[a]

Activity	Tasks	Duration
Right-of-way Acquisition	Proceed with right-of-way acquisitions once State Legislature appropriates funds in annual budget	March 2013–March 2015
Survey and Preconstruction	Locate utilities, establish right-of-way and project control points and centerlines, establish or relocate survey monuments	March 2013–October 2013
Mobilization	Safety devices and special construction equipment mobilization	June 2013–July 2014
Site Preparation	Utilities relocation; clearing/grubbing right-of-way; establishment of detours and haul routes; preparation of construction equipment yards, stockpile materials, and precast concrete segment casting yard	July 2013–July 2017 (two site preparation periods)
Earth Moving	Excavation and earth support structures	December 2013–August 2015
Construction of Road Crossings	Surface street modifications, grade separations	December 2013–August 2015
Construction of Aerial Structures	Aerial structure and bridge foundations, substructure, and superstructure	December 2013–December 2017
Track Laying	Includes backfilling operations and drainage facilities	May 2016–December 2017
Systems	Train control systems, overhead contact system, communication system, signaling equipment	March 2018–January 2021
Demobilization	Includes site cleanup	August 2017–June 2022 (two demobilization periods)
HMF Phase 1[b]	Test Track Assembly and Storage	April 2017–November 2017
HMF Phase 2[b]	Test Track Light Maintenance Facility	April 2017–December 2018
Maintenance-of-Way Facility	Potentially collocated with HMF[a]	April 2017–December 2018
HMF Phase 3[b]	Heavy Maintenance Facility	January 2018–July 2019
HST Stations	Demolition, site preparation, foundations, structural frame, electrical and mechanical systems, finishes	Fresno: May 2019–May 2022 Kings/Tulare Regional: TBD[c] Bakersfield: May 2019–May 2022

Table 2-1
Approximate Construction Schedule[a]

Activity	Tasks	Duration

Notes:

[a] Based on a two-phase implementation of the project: first construction will meet the ARRA funding deadline and be completed in 2017; the remainder of the Initial Operating Segment will be completed by 2022 per the Business Plan and based on anticipated funding flow.
[b] HMF would be sited in either the Merced to Fresno or Fresno to Bakersfield Section.
[c] Right-of-way would be acquired for the Kings/Tulare Regional Station; however, the station itself would not be part of initial construction.

Acronym:

TBD = to be determined

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Section 3.0
Regulatory Framework

3.0 Regulatory Framework

Key regulations for hydrology and water resources that are most relevant to the proposed project are summarized below.

3.1 Federal Regulations

3.1.1 Clean Water Act (33 United States Code [U.S.C.] 1251 et seq.)

The federal Clean Water Act (CWA) is the primary federal law that protects the quality of the nation's surface waters, including lakes, rivers, and coastal wetlands. The primary principle is that any discharge of pollutants into the nation's waters is prohibited unless specifically authorized by a permit; permit review is the CWA's primary regulatory tool. The applicable sections of the CWA are further discussed below.

3.1.1.1 Permit for Fill Material in Waters and Wetlands (Section 404)

Section 404 establishes a permit program administered by the USACE, which regulates the discharge of dredged or fill material into waters of the United States (including wetlands).

3.1.1.2 National Pollutant Discharge Elimination System Program (Section 402)

Section 402 establishes a permitting system for the discharge of any pollutant (except dredge or fill material) into waters of the United States. It requires a National Pollutant Discharge Elimination System (NPDES permit from the Regional Water Quality Control Board (RWQCB) for discharges.

3.1.1.3 Clean Water Quality Certification (Section 401)

Section 401 requires that an applicant for a federal license or permit to allow activities that would result in a discharge to waters of the United States obtain a state certification that the discharge complies with other provisions of the CWA. The RWQCBs administer the certification program in California.

3.1.1.4 Water Quality Impairments (Section 303[d])

Section 303(d) requires each state to provide a list of impaired waters that do not meet or are expected not to meet state water quality standards as defined by that section. It also requires the state to develop total maximum daily loads (TMDLs) from the pollution sources for such impaired water bodies.

3.1.2 Section 10 of Rivers and Harbors Act (33 U.S.C. Section 401 et seq.)

Section 10 of the Rivers and Harbors Act requires a permit for creating obstructions (including excavation and fill activities) to the navigable waters of the United States. Navigable waters are defined as those water bodies subject to the ebb and flow of the tide and/or that are used, in their natural condition or by reasonable improvements, as means to transport interstate or foreign commerce.

3.1.3 Section 14 of Rivers and Harbors Act (33 U.S.C. Section 408)

Section 14 of the Rivers and Harbors Act requires permission for the use, including modifications or alterations, of any flood control facility work built by the United States to ensure that the

usefulness of the federal facility is not impaired. The permission for occupation or use is to be granted by "appropriate real estate instrument in accordance with existing real estate regulations." For the USACE facilities, the Section 408 approval, known as Section 408 permit, is required.

Significant alterations or modifications to locally or federally maintained USACE projects are addressed by 33 U.S.C. 408. A technical analysis of applicable hydraulic and hydrology effects is required and may include changes in inflow, changes in water surface profiles and flow distribution, assessment of local and systemwide resultant impacts, upstream and downstream impacts including sediment transport, and/or impacts to existing floodplain management. Additionally, significant alterations must undergo a risk analysis and formal review process prior to approval under 33 U.S.C. 408 (USACE 2008a). Alterations or modifications must comply with federal and state regulations and will be approved only after they are determined not to adversely affect the public interest or impair the USACE project (USACE 2006).

3.1.4 Section 208.10 of the Code of Federal Regulations (CFR) (33 CFR 208.10a[5])

Relatively minor, low impact modifications to locally or federally maintained USACE projects are addressed by 33 CFR 208.10a(5), including modifications to pipes, roads, and similar infrastructure that do not adversely affect the functioning of the project and flood protection measures (USACE 2006).

3.1.5 Floodplain Management (Executive Order 11988)

Executive Order 11988 requires that federal agency construction, permitting, or funding of a project avoid incompatible floodplain development, be consistent with the standards and criteria of the National Flood Insurance Program (NFIP), and restore and preserve natural and beneficial floodplain values.

3.1.6 National Flood Insurance Act (42 U.S.C. Section 4001 et seq.)

The purpose of the National Flood Insurance Act is to identify flood-prone areas and provide insurance. The act requires purchase of insurance for buildings in special flood hazard areas (SFHAs). The act is applicable to any federally assisted acquisition or construction project in an area identified as having special flood hazards. Projects should avoid construction in, or develop a design to be consistent with, Federal Emergency Management Agency (FEMA)-identified flood-hazard areas.

3.1.7 Floodplain Management and Protection (U.S. Department of Transportation Order 5650.2) and Flood Disaster Protection Act (42 U.S.C. Sections 4001 to 4128)

The purpose of these acts is to identify flood-prone areas and provide insurance. The act requires purchase of insurance for buildings in special flood hazard areas.

3.1.8 Safe Drinking Water Act (42 U.S.C. Section 300 et seq.)

The Safe Drinking Water Act (SDWA) is designed to protect the quality of drinking water in the United States. Section 1424(e) of the SDWA established the sole-source aquifer program that allows the U.S. Environmental Protection Agency (U.S. EPA) to review any federally funded project that has the potential to contaminate a sole-source aquifer. A sole-source aquifer is

designated as an aquifer that supplies more than 50% of a community's drinking water supply. U.S. EPA Region 9, which includes California, contains nine designated sole-source aquifers.

3.2 State Regulations

3.2.1 Porter-Cologne Water Quality Act (Water Code Section 13000 et seq.)

The Porter-Cologne Water Quality Act requires projects that are discharging, or proposing to discharge, wastes that could affect the quality of the state's water to file a Report of Waste Discharge with the appropriate RWQCB. The RWQCBs are responsible for implementing CWA, Sections 401, 402, and 303(d). The act also provides for the development and periodic reviews of basin plans that designate beneficial uses of California's major rivers and groundwater basins and establish water quality objectives for those waters. Projects primarily implement basin plans using the NPDES permitting system to regulate waste discharges so that water quality objectives are met.

The State Water Resources Control Board (SWRCB) and RWQCBs are the principal agencies with responsibility for the coordination and control of water quality under this act. The SWRCB allocates water rights, adjudicates water rights disputes, develops statewide water protection plans, establishes water quality standards, and with the nine regional RWQCBs guides policy in the major watersheds of the state. Responsibilities of the RWQCBs are described below.

3.2.2 Statewide Stormwater Permits

In California, the NPDES program is administered by the SWRCB, with implementation and enforcement by the RWQCBs. The NPDES program, which was designed to protect surface water quality, is applicable to all discharges to waters of the United States, including stormwater discharges associated with construction activities, industrial operations, municipal drainage systems, and point sources. In general, the NPDES permit program is designed to control, minimize, or reduce surface water impacts.

3.2.2.1 Stormwater Discharges: General Permit For Construction

Under the federal CWA, discharge of stormwater from construction sites must comply with the conditions of an NPDES permit. The SWRCB is the permitting authority in California and has adopted a statewide *General Permit for Stormwater Discharges Associated with Construction and Land Disturbance Activities* (SWRCB Water Quality Order No. 2009-0009-DWQ, NPDES No. CAS000002) (SWRCB 2009) that applies to projects resulting in 1 or more acres of soil disturbance. Construction activities subject to the permit include clearing, grubbing, grading, stockpiling, and excavating activities. The statewide permit implements a risk-based permitting approach, specifies minimum best management practice (BMP) requirements, and requires stormwater monitoring and reporting.

For projects disturbing more than 1 acre of soil, a construction stormwater pollution prevention plan (SWPPP) is required that specifies site management activities to be implemented during site development. These management activities include implementation of construction stormwater BMPs, erosion and sedimentation controls, dewatering (nuisance water removal) controls, runoff controls, and construction equipment maintenance. Additionally, post-construction management measures must be prepared and a long-term maintenance plan must be implemented at the completion of construction. The Central Valley RWQCB requires a Notice of Intent to be filed prior to any stormwater discharge from construction activities, and that the SWPPP be implemented and maintained onsite.

3.2.2.2 Stormwater Discharges: Industrial NPDES Permit

There is also statewide *Waste Discharge Requirements (WDRs) for Discharges of Storm Water associated with Industrial Activities excluding Construction Activities* (SWRCB Water Quality Order No. 97-03-DWQ, NPDES No. CAS000001) (SWRCB 1997). Qualifying industrial sites are required to prepare SWPPPs describing BMPs that will be employed to protect water quality. Industrial facilities are required to use best conventional pollutant control technology (BCT) for control of conventional pollutants and best available technology economically achievable (BAT) for toxic and non-conventional pollutants. Monitoring of runoff leaving the site is also required. For transportation facilities, this permit applies only to vehicle maintenance shops and equipment-cleaning operations. The state is currently updating this general permit and received public input on the draft permit in 2011. Changes to the permit are expected to include the establishment of numeric action levels (NALs) that reflect the U.S. EPA benchmark values for selected parameters, a compliance storm event (the 10-year, 24-hour event), minimum BMP requirements, a revised monitoring protocol, and three levels of corrective actions if an NAL is exceeded.

3.2.2.3 Stormwater Discharges: Caltrans NPDES Permit

The California Department of Transportation (Caltrans) operates under a permit (SWRCB Water Quality Order No. 99-06-DWQ, NPDES No. CAS000003) (SWRCB 1999) that regulates stormwater discharge from Caltrans properties, facilities, and activities and requires that the Caltrans construction program comply with the adopted statewide General Permit for Stormwater Discharges Associated with Construction Activity (described above). The permit requires Caltrans to implement a year-round program in all parts of the state to effectively control stormwater and non-stormwater discharges (SWRCB 1999). The Caltrans permit is applicable to portions of the project that involve modifications to state highways.

3.2.2.4 Stormwater Discharges: Municipal Separate Storm Sewer System NPDES Permits

Section 402(p) of the CWA requires that stormwater management programs be developed and implemented to meet the requirements for stormwater discharges from municipal separate storm sewer systems (MS4s). MS4 permits have been issued by the SWRCB and RWQCBs in two phases. Phase I MS4 permits are issued to a group of co-permittees encompassing an entire metropolitan area. The Phase II MS4 General Permit (SWRCB Water Quality Order No. 2003-0005-DWQ, NPDES No. CAS000004) (SWRCB 2003a) was adopted by the SWRCB to provide NPDES permit coverage to municipalities not covered under the NPDES Phase I Rule (i.e., small MS4s generally for fewer than 100,000 people).

The MS4 permits require the discharger to develop and implement a stormwater management plan/program. Stormwater management programs limit to the maximum extent practicable (MEP) the discharge of pollutants from storm sewer systems. A single state agency or a coalition, often consisting of more than one municipality (such as cities and counties) may implement these programs. Each program includes BMPs intended to reduce the quantity and improve the quality of stormwater discharged to the stormwater system. Discharges to storm sewer systems must comply with the stormwater management program requirements.

3.2.3 Streambed Alteration Agreement (Sections 1601 to 1603) of the California Fish and Game Code

The California Fish and Game Code requires agencies to notify the California Department of Fish and Game prior to implementing any project that would divert, obstruct, or change the natural flow or bed, channel, or bank of any river, stream, or lake.

3.2.4 Colbey-Alquist Floodplain Management Act (California Water Code Section 8400 et seq.)

The Colbey-Alquist Floodplain Management Act documents the state's intent to support local governments in their use of land use regulations to accomplish floodplain management and to provide assistance and guidance as appropriate.

3.2.5 Central Valley Flood Protection Board (California Code of Regulations [CCR] Title 23, Division 1)

The Central Valley Flood Protection Board (CVFPB) exercises regulatory authority to maintain the integrity of the existing flood control system and designated floodways by issuing permits for encroachments. The CVFPB has mapped designated floodways along more than 60 streams and rivers in the Central Valley. In addition, Table 8.1 of Title 23 CCR contains several hundred stream reaches and waterways that are regulated streams. Projects that encroach within a designated floodway or regulated stream, or within 10 feet of the toe of a state-federal flood control structure (levee), require an encroachment permit and the submission of an associated application, including an environmental assessment questionnaire. A project must demonstrate that it will not reduce the channel flow capacity and that it will comply with channel and levee safety requirements.

The CVFPB enforces standards for the construction, maintenance, and protection of adopted flood control plans that will protect public lands from floods. The jurisdiction of the CVFPB includes the Central Valley and all tributaries and distributaries of Sacramento River, San Joaquin River, and designated floodways (Title 23 CCR Section 2). The CVFPB has all the responsibilities and authorities necessary to oversee future modifications, as approved by the USACE, pursuant to assurance agreements with the USACE and the USACE Operation and Maintenance Manuals under Title 33 CFR Section 208.10 and Title 33 U.S.C. Section 408.

Under Title 33 U.S.C. Section 408, the USACE must approve proposed modifications that involve a federal flood control project. A Section 408 permit would be required if construction modifies a federal levee. Title 33 CFR Section 208.10 requires that construction of improvements, including crossings, does not reduce the capacity of a channel within a federal flood control project. A Section 208.10 permit would be required where the project encroaches on a federal facility but does not modify it. For a proposed crossing that could affect a federal flood control project (levee system or waterway regulated by the USACE), the CVFPB coordinates review of the application with the USACE and with other agencies, as needed.

Work activities such as excavation, cut-and-fill construction, and obstruction within the floodway and on levees adjacent to a regulated stream are not allowed during the flood season, as defined in Title 23. The flood season for the project area, as defined by CVFPB for floodways, is November 1 through July 15. The CVFPB grants exemptions to this time restriction if they determine that forecasts for weather or river flood conditions are favorable. Uses that do not impede the free flow in the floodway or jeopardize public safety are permitted within a designated floodway. These permitted uses include structures that do not impede flows and are anchored to prevent the structure from floating; roads, pipelines, fences, and walls that do not obstruct flood flows; and storage yards for equipment and materials that are securely anchored or can be removed upon notice.

3.2.6 Senate Bill 5: 200-Year Flood Criteria

Senate Bill 5, implemented in October 2007, required the California Department of Water Resources (DWR) to develop preliminary maps for the 100- and 200-year floodplains in the Sacramento-San Joaquin Valley watershed by July 1, 2008. The maps provide the best available

information on flood protection to cities and counties, showing areas protected by state-federal project levees and areas outside the protection of project levees. DWR has prepared preliminary 100- and 200-year maps for 32 counties within the Sacramento-San Joaquin Valley watershed, including Fresno County. Lands within the Tulare Lake Basin are not subject to preliminary mapping under Senate Bill 5 (DWR 2010).

3.2.7 Central Valley Flood Protection Act

The Central Valley Flood Protection Act of 2008 establishes the 200-year flood event as the minimum level of flood protection for urban and urbanizing areas. As part of the state's FloodSAFE program, those urban areas protected by flood-control project levees must receive protection from the 200-year flood event level by 2025. DWR and the CVFPB are collaborating with local governments and planning agencies to prepare and adopt the Central Valley Flood Protection Plan (CVFPP) by mid-2012. The objective of the CVFPP is to create a system-wide approach to flood management and protection improvements for portions of the Central Valley (Sacramento Valley and San Joaquin Valley).

3.3 Regional and Local Regulations

This section discusses local and regional regulations and permitting requirements. Cities and counties within the study area, as well as regional agencies, have developed ordinances, policies, and other regulatory mechanisms to minimize negative effects during a project's construction and operation. The following local plans and policies were identified.

3.3.1 Regional Water Quality Control Boards

The RWQCB was established in the Porter-Cologne Act. The Fresno to Bakersfield Section of HST project lies within the boundary of the Central Valley RWQCB, which makes water quality decisions for the region. Its responsibilities include setting water quality standards for surface waters and groundwater, implementing the NPDES program, issuing waste discharge requirements, determining compliance with those requirements, and taking appropriate enforcement actions.

3.3.1.1 Basin Plans and Water Quality Objectives

The RWQCB adopts water quality control plans, or basin plans, that establish water quality objectives to provide reasonable protection of beneficial uses and a program of implementation for achieving water quality objectives within the basin plans. The *Water Quality Control Plan for the Tulare Lake Basin* (Tulare Lake Basin Plan) (Central Valley RWQCB 2004) is the applicable basin plan for the study area. The Tulare Lake Basin Plan designates beneficial uses for specific surface water and groundwater resources, establishes water quality objectives to protect those uses, and sets forth policies to guide the implementation of programs to attain the objectives.

Section 303(d) of the CWA requires that states list waters that are not attaining water quality standards. For these, the RWQCB establishes TMDLs and a program of implementation to meet the TMDL. A TMDL must account for the pollution sources causing the water to be listed.

3.3.1.2 Dewatering Activities: Permit varies by RWQCB

Care is required for the removal of nuisance water from a construction site (known as dewatering), because of the high turbidity and other pollutants potentially associated with this activity. Central Valley RWQCB's *Waste Discharge Requirements for Dewatering and Other Low-Threat Discharges to Surface Waters* (Central Valley RWQCB Order No. R5-2008-0081, NPDES No. CAG95001) (Central Valley RWQCB 2008),covers discharges to surface water from

dewatering activities. The permit covers discharges to surface water provided they do not contain significant quantities of pollutants and either (a) the discharge is 4 months, or less, in duration or (b) the average dry weather discharge does not exceed 0.25 million gallons per day. All pollutants would need to be treated prior to discharge to ensure continuous compliance with applicable water quality requirements.

Discharges to land from dewatering activities are covered under SWRCB Order No. 2003-0003-DWQ, *Statewide General Waste Discharge Requirements (WDRs) for Discharges to Land with a Low Threat to Water Quality (General WDRs)* (SWRCB 2003b).

3.3.2 Stormwater Management Programs

Stormwater discharges are permitted under the NPDES program. Municipal MS4 permits, which include Phase I individual permits and the Phase II MS4 General Permit, require municipalities to develop and implement a stormwater management program. Stormwater management plans (SWMPs) applicable to the project include the following:

- Fresno Metropolitan Area Storm Water Management Plan (Central Valley RWQCB 2001c).
- City of Hanford Storm Water Management Plan (City of Hanford 2005).
- Tulare County Stormwater Management Plan (Tulare County 2008).
- Kern County and the City of Bakersfield Stormwater Management Plan (Kern County and City of Bakersfield 2005).

3.3.2.1 Fresno Metropolitan Area Stormwater Management Plan

Stormwater discharges to the municipal system in the Fresno metropolitan area are permitted under Central Valley RWQCB Order No. 5-01-048, NPDES Permit No. CA0083500, *Waste Discharge Requirements for Fresno Metropolitan Flood Control District, City of Fresno, City of Clovis, County of Fresno, and California State University Fresno for Urban Stormwater Discharges, Fresno County* (Central Valley RWQCB 2001a). In accordance with this NPDES permit, the co-permittees have prepared an SWMP that outlines the BMPs that would be implemented to prevent the discharge of pollutants in stormwater.

Fresno Metropolitan Flood Control District (FMFCD) operates an MS4 that collects water from the cities of Fresno and Clovis, Fresno County, and California State University at Fresno. The SWMP discusses BMP programs that need to be implemented to remove pollutants from stormwater to the MEP. Specific tasks are described for the BMP programs, which include public involvement and education, illicit discharges, structural controls, operations and maintenance, construction and development, commercial and industrial, and source identification monitoring.

FMFCD, in coordination with the other local agencies, operates and maintains a stormwater management system that includes storm drains, detention and retention basins, and pump stations. FMFCD's district services plan describes stormwater management within the city of Fresno. The district services plan identifies 163 adopted or proposed drainage areas covering approximately 1 to 2 square miles and their associated drainage basins within Fresno.

Detention and retention basins, located on all but five of the developed drainage areas, are components of FMFCD's water conservation program, because they also function as groundwater recharge basins. FMFCD contracts and coordinates with the Fresno Irrigation District (FID) and the City of Fresno with regard to groundwater recharge efforts (FMFCD 2009). The drainage basins are used in FMFCD service areas and Fresno County to remove pollutants from urban runoff and prevent pollutants in stormwater from reaching receiving waters. Approximately 90% of the urban runoff is retained in stormwater basins, approximately 8% is discharged to the San Joaquin River or canals after detention in basins, and the remaining 2% is discharged directly to the San Joaquin River or canals (Central Valley RWQCB 2001a).

3.3.2.2 Tulare County NPDES Phase II Stormwater Management Plan

Stormwater discharges to Tulare County's municipal system are regulated by the Phase II MS4 General Permit (SWRCB 2003a). The Tulare County SWMP outlines and directs the county's stormwater-related priorities and activities. The county currently operates and maintains storm drain systems that include drainage channels, 86 detention and retention basins, 24 pump stations, and approximately 6 miles of pipe. Runoff historically has been directed to natural creeks and rivers by gravity flow or by pumping. The county has been working to develop additional infrastructure to drain increased runoff caused by urbanization. Detention reservoirs and temporary drainage basins have been proposed to address the water quality of runoff. The SWMP describes measurable goals, control measures, and public programs to minimize the amount of pollutants discharged through the stormwater system and to enhance and protect stormwater quality in Tulare County. Tulare County will increase the existing level of stormwater protection by implementing additional BMPs as part of the minimum control measures.

The SWMP also discusses the development and implementation of programs to involve and increase awareness of the public with regard to stormwater discharges. Programs include development of educational brochures, development of a stormwater web site, public stakeholder meetings, and storm drain stenciling. With regard to illicit discharges, the SWMP includes measures such as the development and implementation of a regular maintenance program, specific inspection and illicit discharge source removal procedures, and a storm drainage system map to assist in monitoring, evaluating, and maintaining stormwater. As part of the SWMP, construction activities are required to undergo a site plan review before issuance of a grading permit, to submit an NPDES compliance assurance deposit, and to comply with the county construction and demolition debris ordinance. Additional planning and training, enforcement of post-construction controls, and pollution prevention, are also planned to satisfy the required minimum control measures (Tulare County 2008).

3.3.2.3 Kern County Stormwater Management Plan

Kern County, including the city of Bakersfield, is permitted to discharge urban stormwater under Central Valley RWQCB Order No. 5-01-130, NDPES No. CA00883399, *Waste Discharge Requirements for the County of Kern and the City of Bakersfield for Urban Stormwater Discharges, Kern County* (Central Valley RWQCB 2001b). The majority of stormwater runoff in the Bakersfield metropolitan area is directed to retention basins, with a small amount of runoff directed to Kern River or canals. Detention basins treat stormwater in approximately 40% of the drainage area to help meet water quality objectives. Discharges to Kern River and canals are required to comply with water quality objectives and policies in the Tulare Lake Basin Plan. Kern County and the City of Bakersfield are required to sample discharge from residential, commercial, and industrial areas during two storm events each year to evaluate water quality. New developments are generally required to include retention or detention basins. Building permits continue to include stormwater control provisions and ensure compliance with the requirements for the general permits for the discharge of stormwater associated with industrial and construction activities.

The SWMP also addresses illicit discharge controls by requiring the reporting of complaints regarding illegal dumping and the quantifying of hazardous materials spills (Central Valley RWQCB 2001b).

3.3.2.4 Hanford Stormwater Management Plan

The city of Hanford is a rural community in Kings County that relies on water resources to support its agricultural economy. Hanford depends on groundwater pumped from local wells for water supply (City of Hanford 2005). Hanford, in cooperation with the Peoples Ditch Company

and the Kings County Water District, delivers excess flows from Kings River, along with stormwater runoff, into the 164 acres of drainage and slough basins throughout the city to replenish groundwater (City of Hanford 2005). The city's existing drainage infrastructure includes natural drainage channels, irrigation canals, retention/recharge basins, piping and pump stations. Peoples Ditch Company receives water from Kings River and delivers water for agricultural irrigation. During high stormwater flow periods, Peoples Ditch Company also receives stormwater runoff and conveys it to various basins for stormwater retention and groundwater recharge. Peoples Ditch Company is limited to a maximum discharge of 50 cubic feet per second (cfs) (Valley Planning Consultants, Inc. 2002).

In March 2003, the city of Hanford was designated as a small MS4 under the Phase II MS4 General Permit. The city of Hanford's SWMP (City of Hanford 2005) was prepared to comply with the Phase II MS4 General Permit and addresses the required six minimum control measure categories. The SWMP complements the city's storm drain master plan and includes BMPs to reduce discharge of pollutants to the MEP, to protect water quality, and to satisfy water quality requirements set forth by the CWA. The SWMP discusses the implementation of specific BMPs and assigns responsibilities to different city departments for their implementation.

3.3.3 General Plan Policies and Ordinances

3.3.3.1 Fresno County General Plan

Fresno County's General Plan (adopted October 2000) provides the framework for the protection of the county's water resources and water quality. The Open Space and Conservation Element is concerned with protecting and preserving natural resources. The policies that specifically deal with water resources and water quality within the study area include:

Goal OS-A: To protect and enhance the water quality and quantity in Fresno County's streams, creeks, and groundwater basins.

- Policy OS-A.1: The county shall develop, implement, and maintain a plan for achieving water resource sustainability, including a strategy to address overdraft and the needs of anticipated growth.
- Policy OS-A.2: The county shall provide active leadership in the regional coordination of water resource management efforts affecting Fresno County and shall continue to monitor and participate in, as appropriate, regional activities affecting water resources, groundwater, and water quality.
- Policy OS-A.3: The county shall provide active leadership in efforts to protect, enhance, monitor, and manage groundwater resources within its boundaries.
- Policy OS-A.4: The county shall update, implement, and maintain its Groundwater Management Plan.
- Policy OS-A.13: The county shall encourage, where economically, environmentally, and technically feasible, efforts aimed at directly or indirectly recharging the county's groundwater.
- Policy OS-A.15: The county shall, to the maximum extent possible, maintain local groundwater management authority and pursue the elimination of unwarranted institutional, regulatory, permitting, and policy barriers to groundwater recharge within Fresno County.

- Policy OS-A.16: The county shall permit and encourage, where economically, environmentally, and technically feasible, over-irrigation of surface water as a means to maximize groundwater recharge.
- Policy OS-A.17: The county shall directly and/or indirectly participate in the development, implementation, and maintenance of a program to recharge the aquifers underlying the county. The program shall make use of flood and other waters to offset existing and future groundwater pumping.
- Policy OS-A.18: The county shall require that natural watercourses are integrated into new development in such a way that they are accessible to the public and provide a positive visual element and a buffer area between waterways and urban development in an effort to protect water quality and riparian areas.
- Policy OS-A.19: The county shall require the protection of floodplain lands and, where appropriate, acquire public easements for purposes of flood protection, public safety, wildlife preservation, groundwater recharge, access, and recreation.
- Policy OS-A.21: The county shall, where economically, environmentally, and technically feasible, encourage the multiple use of public lands, including county lands, to include groundwater recharge.
- Policy OS-A.23: The county shall protect groundwater resources from contamination and overdraft by pursuing the following efforts: identifying and controlling sources of potential contamination; protecting important groundwater recharge areas; encouraging water conservation efforts and supporting the use of surface water for urban and agricultural uses wherever feasible; encouraging the use of treated wastewater for groundwater recharge and other purposes (e.g., irrigation, landscaping, commercial, and non-domestic uses); supporting consumptive use where it can be demonstrated that this use does not exceed safe yield and is appropriately balanced with surface water supply to the same area; considering areas where recharge potential is determined to be high for designation as open space; and developing conjunctive use of surface and groundwater.
- Policy OS-A.24: The county shall require new development near rivers, creeks, reservoirs, or substantial aquifer recharge areas to mitigate any potential impacts of release of pollutants in stormwaters, flowing river, stream, creek, or reservoir waters.
- Policy OS-A.25: The county shall minimize sedimentation and erosion through control of grading, cutting of trees, removal of vegetation, placement of roads and bridges, and use of off-road vehicles. The county shall discourage grading activities during the rainy season unless adequately mitigated to avoid sedimentation of creeks and damage to riparian habitat.
- Policy OS-A.26: The county shall continue to require the use of feasible and practical BMPs to protect streams from the adverse effects of construction activities and urban runoff.
- Policy OS-A.27: The county shall monitor water quality regularly and take necessary measures to prevent contamination, including the prevention of hazardous materials from entering the wastewater system.
- Policy OS-A.29: In areas with increased potential for groundwater degradation (e.g., areas with prime percolation capabilities, coarse soils, and/or shallow groundwater), the county shall only approve land uses with low risk of degrading groundwater.

The Public Facilities and Services Element includes storm drainage and flood control policies (Fresno County 2000). Policies that specifically deal with water resources and water quality within the study area include those listed below.

Goal PF-A: To ensure the timely development of public facilities and to maintain an adequate level of service to meet the needs of existing and future development.

- Policy PF-A.2: The county shall require new industrial development to be served by community sewer, stormwater, and water systems where such systems are available or can feasibly be provided.
- Policy PF-C.2: The county shall actively engage in efforts and support the efforts of others to import flood, surplus, and other available waters for use in Fresno County.
- Policy PF-C.3: To reduce demand on the county's groundwater resources, the county shall encourage the use of surface water to the maximum extent feasible.
- Policy PF-C.5: The county shall develop a county water budget to determine long-term needs and to determine whether existing and planned water resource enhancements will meet the county's needs over the 20-year General Plan horizon.
- Policy PF-C.7: The county shall recommend to all cities and urban areas within the county that they adopt the most cost-effective urban BMPs published and updated by the California Urban Water Agencies, California DWR, or other appropriate agencies as a means of meeting some of the future water supply needs.

Goal PF-E: To provide efficient, cost-effective, and environmentally sound storm drainage and flood control facilities that protect both life and property and to divert and retain stormwater runoff for groundwater replenishment.

- Policy PF-E.1: The county shall coordinate with the agencies responsible for flood control or storm drainage to ensure that construction and acquisition of flood control and drainage facilities are adequate for future urban growth authorized by the county General Plan and city general plans.
- Policy PF-E.2: The county shall encourage the agencies responsible for flood control or storm drainage to coordinate the multiple uses of flood control and drainage facilities with other public agencies.
- Policy PF-E.3: The county shall encourage the FMFCD to spread the cost of construction and acquisition of flood control and drainage facilities in the most equitable manner consistent with the growth and needs of this area.
- Policy PF-E.4: The county shall encourage the local agencies responsible for flood control or storm drainage to require that storm drainage systems be developed and expanded to meet the needs of existing and planned development.
- Policy PF-E.5: The county shall only approve land use-related projects that will not render inoperative any existing canal, encroach upon natural channels, and/or restrict natural channels in such a way as to increase potential flooding damage.
- Policy PF-E.6: The county shall require that drainage facilities be installed concurrently with and as a condition of development activity to ensure the protection of the new improvements as well as existing development that might exist within the watershed.

- Policy PF-E.7: The county shall require new development to pay its fair share of the costs of Fresno County storm drainage and flood control improvements within unincorporated areas.
- Policy PF-E.8: The county shall encourage the local agencies responsible for flood control or storm drainage to precisely locate drainage facilities well in advance of anticipated construction, thereby facilitating timely installation and encouraging multiple construction projects to be combined, reducing the incidence of disruption of existing facilities.
- Policy PF-E.9: The county shall require new development to provide protection from the 100-year flood as a minimum.
- Policy PF-E.10: In growth areas within the jurisdiction of a local agency responsible for flood control or storm drainage, the county shall encourage that agency to design drainage facilities as if the entire areas of service were developed to the pattern reflected in the adopted General Plans to ensure that the facilities will be adequate as the land use intensifies.
- Policy PF-E.11: The county shall encourage project designs that minimize drainage concentrations and maintain, to the extent feasible, natural site drainage patterns.
- Policy PF-E.12: The county shall coordinate with the local agencies responsible for flood control or storm drainage to ensure that future drainage system discharges comply with applicable state and federal pollutant discharge requirements.
- Policy PF-E.13: The county shall encourage the use of natural stormwater drainage systems to preserve and enhance natural drainage features.
- Policy PF-E.14: The county shall encourage the use of retention-recharge basins for the conservation of water and the recharging of the groundwater supply.
- Policy PF-E.15: The county should require that retention-recharge basins be suitably landscaped to complement adjacent areas and should, wherever possible, be made available to the community to augment open space and recreation needs.
- Policy PF-E.16: The county shall minimize sedimentation and erosion through control of grading, cutting of trees, removal of vegetation, placement of roads and bridges, and use of off-road vehicles. The county shall discourage grading activities during the rainy season, unless adequately mitigated, to avoid sedimentation of creeks and damage to riparian habitat.
- Policy PF-E.17: The county shall encourage the local agencies responsible for flood control or storm drainage retention-recharge basins in soil strata strongly conductive to groundwater recharge to develop and operate those basins in such a way as to facilitate year-round groundwater recharge.
- Policy PF-E.18: The county shall encourage the local agencies responsible for flood control or storm drainage to plan retention-recharge basins on the principle that the minimum number will be the most economical to acquire, develop, operate, and maintain.
- Policy PF-E.19: In areas where urbanization or drainage conditions preclude the acquisition and use of retention-recharge basins, the county shall encourage the local agencies responsible for flood control or stormwater drainage to discharge storm or drainage water into major canals and other natural watercourses subject to the following conditions: the volume of discharge is within the capacity of the canal or natural watercourse to carry the water; the discharge complies with the requirements of applicable state and federal

regulations (e.g., NPDES); and the agency responsible for ownership, operation, or maintenance of the canal or natural watercourse approves of the discharge.

- Policy PF-E.20: The county shall require new development of facilities near rivers, creeks, reservoirs, or substantial aquifer recharge areas to mitigate any potential impacts of release of pollutants in flood waters, flowing rivers, streams, creeks, or reservoir waters.
- Policy PF-E.21: The county shall require the use of feasible and practical best BMPs to protect streams from the adverse effects of construction activities, and shall encourage the urban storm drainage systems and agricultural activities to use BMPs.
- Policy PF-E.22: The county shall encourage the local agencies responsible for flood control or storm drainage to control obnoxious odors or mosquito breeding conditions connected with any agency facility by appropriate measures.

3.3.3.2 Fresno County Ordinances

Fresno County Ordinance Code, Title 14 Water and Sewage, Chapter 14.03 Groundwater Management

The groundwater management ordinance makes provisions for the protection of the health, welfare, and safety of the county by dedicating the county to proactively assist local water agencies in obtaining and maintaining adequate water supplies and cooperatively implementing joint groundwater management practices consistent with the plan goals of the Fresno County groundwater management plan. Protecting county groundwater resources includes the adoption of a permit addressing the extraction of groundwater for long-term use outside of the county and the insurance of continued vitality of the county's agriculture industry, the economy as a whole, and the general welfare of the citizens of the county.

Fresno County Ordinance Code, Title 14 Water and Sewage, Chapter 14.04 Well Regulations

The well regulations ordinance sets forth well construction, pump installation, and well destruction standards to protect the public health; describes administrative procedures for obtaining permits; and establishes the right for a health officer inspection during any construction, reconstruction, repair, or destruction of water wells.

Fresno County Ordinance Code, Title 14 Water and Sewage, Chapter 14.08 Well Construction, Pump Installation and Well Destruction Standards

The well construction, pump installation, and well destruction standards provide guidance on water well locations with respect to potential sources of contamination and pollution, on depths to which well casings shall be sealed, on well openings, and on disinfection. The standards also establish requirements for well development, repair or deepening, abandonment, and destruction.

Fresno County Ordinance Code, Title 15 Building and Construction, Chapter 15.48 Flooding Hazard Areas

The flooding hazard areas ordinance restricts or prohibits uses that are dangerous to health, safety, and property due to water or erosion hazards or that result in damaging increases in erosion or in flood heights or velocities; requires that uses vulnerable to floods, including facilities that serve such uses, be protected against flood damage at the time of initial construction; controls the alteration of natural floodplains, stream channels, and natural protective barriers that help accommodate or channel floodwaters; controls such filling, grading, dredging, and other

development that may increase flood damage; and prevents or regulates the construction of flood barriers that will unnaturally divert floodwaters or that may increase flood hazards in other areas.

3.3.3.3 The Fresno Metropolitan Flood Control District

The FMFCD Act of 1955 mandates a quasi-joint powers relationship among the City of Fresno, City of Clovis, and Fresno County to provide coordinated and comprehensive stormwater management services for the region. FMFCD requires that stormwater systems be designed for only a 2-year rainfall event, since it is assumed that excess stormwater runoff can be conveyed as overflow on streets. The cities of Fresno and Clovis have agreements with the FMFCD, which, over time, provide for access to an expanding number of master planned flood control basins for groundwater recharge.

The FMFCD Act of 1955 mandates the provision of urban stormwater drainage services and the protection of property from flood, storm, and other water flows. While it does not specifically mandate management of stormwater quality as a purpose of FMFCD, management of the quality of stormwater and mitigation of potential pollutant-related impacts are considered essential to carrying out the mandated flood control, drainage, water conservation, and recharge activities. Objectives and purposes of the act are as follows:

- The control of flood, storm, and other waste waters of or within the district, including waters which arise outside the district and which flow or drain into or through the district.
- The protection from damage by flood, storm, or waste waters of private property and of public highways and other public property within the district.
- The conservation of flood, storm, waste, and other surface waters for beneficial and useful purposes by spreading, storing, retaining, or causing those waters, or any part thereof, to percolate into the soil within or without the district, or the saving and conservation in any manner of any or all of those waters.

FMFCD, Fresno County, City of Fresno, and City of Clovis maintain a Master Discharge Agreement with the FID (January 7, 1972). Under the terms of the agreement, FMFCD may discharge stormwater into designated FID canals to prevent flooding. FMFCD's discharges are permissible as long as they do not overtax canal capacity, cause damage, endanger personal property, deposit poor-quality water, or interfere with the primary use of the FID system, which is to transport and distribute irrigation water.

3.3.3.4 The Fresno Metropolitan Flood Control District Ordinances

FMFCD Ordinance 96-1, Chapter 6 Urban Stormwater Quality Management and Discharge Control protects and enhances the water quality of watercourses and water bodies in accordance with the CWA by reducing pollutants in urban stormwater discharges to the MEP through the prohibition of non-stormwater discharges to the storm drain system.

3.3.3.5 Kings County General Plan

The Kings County General Plan regulates development activities and land uses in Kings County. Land use designations and policies provide guidance on community development, encourage efficient land use and public services, and preserve natural resources (Kings County 2009a). Policies addressing preservation of water resources and water quality that are applicable to the study area are listed below.

The Land Use Element discusses objectives and policies regarding the protection of natural waterways and land use for flood protection and drainage.

- LU Objective A1.2: Protect natural waterways to ensure continued water delivery and recharge to surrounding agricultural uses and related home sites, while maintaining the natural aesthetic appeal of Kings River and Cross Creek waterway channels.
  - LU Policy A1.2.1: Water channels and riparian habitat along Kings River and Cross Creek shall be designated "Natural Resource Conservation" with a minimum parcel size the same as the surrounding agricultural zone (i.e., AG-20, AG-40, or AX). This designation shall include the natural water channel and outer edge of the riparian vegetation, or to the exterior toe of the bank of the channel where absent of vegetation.
  - LU Policy A1.2.2: Natural Resource Conservation designated areas along waterways shall allow irrigation, flood control, and drainage facilities as "Permitted Uses."
  - LU Policy A1.2.5: All new temporary and permanent structures proposed by private land owners within designated floodway channels as identified by FEMA shall be submitted to the county for review and required to comply with Kings River Resource Conservation District requirements, and all other applicable federal, state, and local agency requirements.
- LU Objective B6.2: Identify agricultural areas that may serve as emergency floodwater storage or drainage areas.
  - LU Policy B6.2.1: Flood zones within the General Agriculture designations shall be considered appropriate land use areas that have the potential to receive emergency floodwater. Specific basin sites shall be determined by the relevant water, irrigation, reclamation, or flood control district having authority over territories along waterways and the Tulare Lake Basin.

The Resource Conservation Element provides guidance on protecting and maintaining groundwater as a water resource and using surface water as a water supply.

- RC Goal A1: Beneficially use, efficiently manage, and protect water resources while developing strategies to capture additional water sources that may become available to ensure long-term sustainable water supplies for the region.
  - RC Policy A1.1.1: Cooperate with water purveyors and water management agencies to manage groundwater resources within the county to ensure an adequate, safe, and reliable groundwater supply for existing and future water users.
  - RC Policy A1.1.4: Work cooperatively with state and federal land managers to coordinate watershed management on public land.
  - RC Policy A1.1.5: Encourage and support regional groundwater management strategies such as an Integrated Regional Water Management Plan.
  - RC Policy A1.1.6: Support expansion of joint management of surface water and groundwater supplies that contributes to the protection, reliability, and sustainability of local and regional water supplies.
- RC Objective A1.4: Protect the quality of surface water and groundwater resources in accordance with applicable federal, state, and regional requirements and regulations.

  - RC Policy A1.4.1: Evaluate proposed land uses and development projects for their potential to create surface and groundwater contamination from point and non-point sources. Confer with other appropriate agencies, as necessary, to ensure adequate water quality review to prevent soil erosion; direct discharge of potentially harmful substances; ground leaching from storage of raw materials, petroleum products, or waste; floating debris; and runoff from the site.
  - RC Policy A1.4.2: Monitor and enforce provisions to control water pollution contained in the U.S. EPA NPDES program as implemented by the California Water Quality Control Board, Central Valley Region.
  - RC Policy A1.4.3: Require the use of feasible and cost-effective BMPs and other measures designed to protect surface water and groundwater from the adverse effects of construction activities and urban and agricultural runoff in coordination with the California Water Quality Control Board, Central Valley Region.

- RC Objective A1.6: Protect groundwater quality by applying development standards which seek to prevent pollution of surface or groundwater and net loss of natural water features.
  - RC Policy A1.6.3: Protect groundwater by enforcing the requirements for installation of wells in conformity with the California Water Code, the Kings County Well Ordinance, and other pertinent state and local requirements.

- RC Objective A2.1: Maintain the existing Kings River water conveyance system as a designated floodway, and encourage the preservation of riparian habitat along the Kings River consistent with state and federally mandated flood control purposes.
  - RC Policy A2.1.1: Recognize the Kings River Conservation District's responsibility to maintain Kings River channels and levees for flood control purposes. On land within the floodway, allow farming and other uses that are consistent with the designated floodway regulations and any requirements of the Central Valley Flood Protection Board.
  - RC Policy A2.1.2: Apply the "Natural Resource Conservation" land use designation along the Kings River, Cross Creek, and in environmentally sensitive areas having existing natural watercourses, drainage basins, sloughs, or other natural water features. Permitted uses within designated floodway channels shall be limited to uses such as flood control channels, water pumping stations and reservoirs, irrigation ditches, water recharge basins, limited open public-recreational uses such as passive riverside parks, related incidental structures, and agricultural crop production that does not include permanent structures. Any construction or development in this designation along the Kings River designated floodway channel shall be subject to the encroachment permit process required by the Central Valley Flood Protection Board.
  - RC Policy A2.1.4: Coordinate the review of all development proposals within or adjacent to designated floodways with relevant resource conservation district entities to ensure compliance with Central Valley Flood Protection Board requirements, and local Floodplain Administration requirements.

The Safety Element gives direction on development as relates to the potential for flooding.

- HS Objective A4.1: Direct new growth away from designated flood hazard risk areas, and regulate new development to reduce the risk of flood damage to an acceptable level.

- HS Policy A4.1.1: Review new development proposals against current FEMA digital flood insurance rate maps (FIRMs) and California Department of Water Resources special flood hazard maps to determine project site susceptibility to flood hazard.
- HS Policy A4.1.3: Determine base flood elevations (BFEs) for new development proposals within or adjacent to 100-year flood zone areas, as identified in the latest FEMA digital FIRM, to definitively assess the extent of property potentially subject to onsite flood hazards and risks.
- HS Policy A4.1.4: Direct new urban growth to existing cities and community districts, or away from New Community Discouragement Areas to avoid flood hazard areas and increased risk to people and property.
- HS Policy A4.1.5: Regulate development, water diversion, vegetation removal, and grading to minimize any increase in flood damage to people and property.
- HS Policy A4.1.6: New development shall provide onsite drainage or contribute towards their fair share cost of offsite drainage facilities to handle surface runoff.
- HS Policy A4.1.7: Consider and identify all areas subject to flooding in the review of all land divisions and development projects.
- HS Policy A4.1.8: Enforce the "Kings County Flood Damage Prevention Ordinance," Chapter 5A of the Kings County Code of Ordinances.

3.3.3.6 Kings River Conservation District

The Kings River Conservation District (KRCD) was formed through special state legislation in 1950 to protect natural resources in the San Joaquin Valley. This resource management agency for the Kings River region provides flood protection and works with other agencies toward a balanced and high-quality water supply (KRCD 2009a). KRCD protects Kings River channels and levees by providing year-round maintenance along approximately 140 levee miles, monitoring levee banks during flood releases, and removing debris during high water (KRCD 2009b). KRCD has monitored Kings River water quality since 1978, and has increased its focus on water quality as the State of California has become increasingly interested in water quality in recent years. KRCD formed the Southern San Joaquin Valley Water Quality Coalition with seven other agencies in the Tulare Lake Basin, with a goal of protecting and preserving water quality (KRCD 2009c).

KRCD cooperates with the Upper Kings Basin Water Forum to implement the Integrated Regional Water Management Plan (IRWMP) (WRIME 2007). The IRWMP sets forth the following goals related to water resources and flooding in the region.

- Halt, and ultimately reverse, the current overdraft, and provide for sustainable management of surface and groundwater.
- Increase the water supply reliability, enhance operational flexibility, and reduce system constraints.
- Improve and protect water quality.
- Provide additional flood protection.

The water resource objectives that relate to the proposed project in the study area include:

- Define local and regional opportunities for groundwater recharge, water reuse/reclamation, and drinking water treatment.

- Develop large-scale regional conjunctive use projects and artificial recharge facilities to:
  - Enhance operational flexibility of existing water facilities, consistent with existing agreements, entitlements, and water rights.
  - Improve the ability to store available sources of surface water in the groundwater basin.
  - Capture stormwater and flood water currently lost in the region.
  - Provide multipurpose groundwater recharge facilities that provide flood control, recreation, and ecosystem benefits.
- Promote 'in-lieu' groundwater recharge to reduce reliance on groundwater through reclamation and reuse of treated wastewater, surface water treatment and delivery for municipal drinking water, and delivery of untreated water for agricultural use.
- Negotiate and develop institutional arrangements and cost sharing for water banking, water exchange, water reclamation, and water treatment.
- Design programs to improve water conservation and water use efficiency by all water users.
- Identify interconnections or improvement of conveyance systems to provide multiple benefits.

3.3.3.7 Kings County Ordinances

Kings County Code of Ordinances, Chapter 5A Flood Damage Prevention

The flood damage prevention ordinance (Kings County 2009b) restricts or prohibits uses that are dangerous to health, safety, and property due to water or erosion hazards or that result in damaging increases in erosion or in flood heights or velocities; requires that uses vulnerable to floods, including facilities that serve such uses, be protected against flood damage at the time of initial construction; controls the alteration of natural floodplains, stream channels, and natural protective barriers that help accommodate or channel floodwaters; controls such filling, grading, dredging, and other development that may increase flood damage; and prevents or regulates the construction of flood barriers that will unnaturally divert floodwaters or that may increase flood hazards in other areas.

Kings County Code of Ordinances, Chapter 14A Water Wells

The water wells ordinance provides guidelines to protect health, safety, and general welfare in Kings County for work associated with water wells; establishes permit administrative procedures and requirements; regulates construction, repair, reconstruction, and destruction of wells according to state and local standards; designates special protection areas where groundwater quality issues are known to exist; establishes inspection procedures; requires completion reports by drillers; and establishes enforcement of well standards.

3.3.3.8 Tulare County General Plan

The Tulare County General Plan Goals and Policies Report establishes and describes county objectives with regard to water resources, water quality, and flood control (Tulare County 2010).

The agriculture chapter considers water quality in agricultural practices within the county in the following goal and policy.

Goal AG-1: To promote the long-term preservation of productive and potentially productive agricultural lands and to accommodate agricultural-support services and agriculturally related activities that supports the viability of agriculture and further the county's economic development goals.

- Policy AG-1.17: Agricultural Water Resources. The county shall seek to protect and enhance surface water and groundwater resources critical to agriculture.

The health and safety chapter establishes flooding policies to minimize the possibility for the loss of life, injury, or damage to property as a result of flood hazards by requiring compliance with federal, state, and local regulations and by regulating development in the 100-year floodplain. Goals and policies applicable to the study area are listed below.

Goal HS-5: To minimize the possibility for loss of life, injury, or damage to property as a result of flood hazards.

- Policy HS-5.1: Development Compliance with federal, state, and local regulations: The county shall ensure that all development within the designated floodway or floodplain zones conforms with FEMA regulations and the Tulare County Flood Damage Prevention Ordinance.
- Policy HS-5.2: Development in Floodplain Zones: The county shall regulate development in the 100-year floodplain zones except as designated on maps prepared by FEMA in accordance with the following:
  - Critical facilities (those facilities which should be open and accessible during emergencies) shall not be permitted.
  - Passive recreational activities (those requiring non-intensive development, such as hiking, horseback riding, picnicking) are permissible.
  - New development and divisions of land, especially residential subdivisions, shall be developed to minimize flood risk to structures, infrastructure, and ensure safe access and evacuation during flood conditions.
- Policy HS-5.3: Participation in federal Flood Insurance Program: The county shall continue to participate in the NFIP.
- Policy HS-5.4: Multi-Purpose Flood Control Measures: The county shall encourage multipurpose flood control projects that incorporate recreation, resource conservation, preservation of natural riparian habitat, and scenic values of the county's streams, creeks, and lakes. Where appropriate, the county shall also encourage the use of flood and/or stormwater retention facilities for use as groundwater recharge facilities.
- Policy HS-5.5: Development in Dam and Seiche Inundation Zones: The county shall review projects for their exposure to inundation due to dam failure. If a project presents a direct threat to human life, appropriate mitigation measures shall be taken, including restriction of development in the subject area.
- Policy HS-5.6: Impacts to Downstream Properties: The county shall ensure that new county flood control projects will not adversely impact downstream properties or contribute to flooding hazards.
- Policy HS-5.7: Mapping of Flood Hazard Areas: The county shall require tentative and final subdivision maps and approved site plans to delineate areas subject to flooding during a 100-year flood event.

- Policy HS-5.8: Road Location: The county shall plan and site new roads to minimize disturbances to banks and existing channels and avoid excessive cuts and accumulations of waste soil and vegetative debris near natural drainage ways.
- Policy HS-5.9: Floodplain Development Restrictions: The county shall ensure that riparian areas and drainage areas within 100-year floodplains are free from development that may adversely impact floodway capacity or characteristics of natural/riparian areas or natural groundwater recharge areas.
- Policy HS-5.10: Flood Control Design: The county shall evaluate flood control projects involving further channeling, straightening, or lining of waterways until alternative multipurpose modes of treatment, such as wider berms and landscaped levees, in combination with recreation amenities, are studied.
- Policy HS-5.11: Natural Design: The county shall encourage flood control designs that respect natural curves and vegetation of natural waterways while retaining dynamic flow and functional integrity.

The water resources chapter sets forth goals and policies such as monitoring groundwater, expanding the use of reclaimed water, enforcing the NPDES program, and requiring the use of BMPs to provide for the current and long-range water needs in Tulare County. Policies focus on protecting the quality and quantity of surface water and groundwater resources, providing a sustainable, long-term supply of water resources, and ensuring new development is consistent with available water resources (Tulare County 2010).

Goal WR-1: To provide for the current and long-range water needs of the county and for the protection of the quality and quantity of surface and groundwater resources.

- Policy WR-1.1: Groundwater Withdrawal: The county shall cooperate with water agencies and management agencies during land development processes to help promote an adequate, safe, and economically viable groundwater supply for existing and future development within the county. These actions shall be intended to help the county mitigate the potential impact on groundwater resources identified during planning and approval processes.
- Policy WR-1.2: Groundwater Monitoring: The county shall support the collection of monitoring data for facilities or uses that are potential sources of groundwater pollution as part of project approvals, including residential and industrial development.
- Policy WR-1.3: Water Export Outside County: The county shall regulate the export of groundwater and surface water resources allocated to users within the county to cities and service providers outside the county to the extent necessary to protect the public health, safety, and welfare. The county shall strive for a “no net loss” where there may be water exchanges serving a public purpose.
- Policy WR-1.6: Expand Use of Reclaimed Water: The county shall encourage the use of tertiary-treated wastewater and household gray water for irrigation of agricultural lands, recreation, and open-space areas, and large landscaped areas as a means of reducing demand for groundwater resources.
- Policy WR-1.7: Collection of Additional Groundwater Information: The county shall support additional studies focused on furthering the understanding of individual groundwater source areas and basins.
- Policy WR-1.8: Groundwater Basin Management: The county shall take an active role in cooperating in the management of the county’s groundwater resources.

- Policy WR-1.9: Collection of Additional Surface Water Information: The county shall support the additional collection of water quality and flow information for the county's major drainages as part of project approvals.

- Policy WR-1.10: Channel Modification: Channel modification shall be discouraged in streams and rivers where it increases the rate of flow, rate of sediment transport, and erosive capacity; have adverse effect on aquatic life; or modify necessary groundwater recharge.

Goal WR-2: To provide for the current and long-range water needs of the county and for the protection of the quality of surface water and groundwater resources.

- Policy WR-2.1: Protect Water Quality: All major land use and development plans shall be evaluated as to their potential to create surface and groundwater contamination hazards from point and non-point sources. The county shall confer with other appropriate agencies, as necessary, to ensure adequate water quality review to prevent soil erosion; direct discharge of potentially harmful substances; ground leaching from storage of raw materials, petroleum products, or wastes; floating debris; and runoff from the site.

- Policy WR-2.2: NPDES Enforcement: The county shall continue to support the state in monitoring and enforcing provisions to control non-point source water pollution contained in the U.S. EPA NPDES program as implemented by the Water Quality Control Board.

- Policy WR-2.3: BMPs: The county shall continue to require the use of feasible BMPs and other mitigation measures designed to protect surface water and groundwater from the adverse effects of construction activities and urban runoff in coordination with the Water Quality Control Board.

- Policy WR-2.4: Construction Site Sediment Control: The county shall continue to enforce provisions to control erosion and sediment from construction sites.

- Policy WR-2.5: Major Drainage Management: The county shall continue to promote protection of each individual drainage basin within the county based on the basins unique hydrologic and use characteristics.

- Policy WR-2.6: Degraded Water Resources: The county shall encourage and support the identification of degraded surface water and groundwater resources and promote restoration where appropriate.

- Policy WR-2.7: Industrial and Agricultural Sources: The county shall work with agricultural and industrial concerns to ensure that water contaminants and waste products are handled in a manner that protects the long-term viability of water resources in the county.

- Policy WR-2.8: Point Source Control: The county shall work with the Regional Water Quality Control Board to ensure that all point source pollutants are adequately mitigated (as part of the CEQA review and project approval process) and monitored to ensure long-term compliance.

- Policy WR-2.9: Private Wells: The county shall ensure that private wells are adequately constructed to provide protection from bacteriological and chemical contamination and do not provide a hazard as to contaminate the aquifer.

- Policy WR-3.9: Establish Critical Water Supply Areas: The county shall designate Critical Water Supply Areas to include the specific areas used by a municipality or community for its water supply system, areas critical to groundwater recharge, and other areas possessing a vital role in the management of the water resources in the county.

- Policy WR-3.10: Diversion of Surface Water: Diversions of surface water or runoff from precipitation shall be prevented where such diversions may cause a reduction in surface water available for needed groundwater recharge.
- Policy WR-3.11: Policy Impacts to Water Resources: The county shall monitor actions taken at the federal and state levels that impact water resources in order to evaluate the effects of these actions on the county's resources.

3.3.3.9 Tulare County Ordinances

Tulare County Code Part 4 Health, Safety and Sanitation, Chapter 13 Wells

The wells ordinance establishes standards to ensure that water produced by wells in Tulare County will be of high quality; regulates the entry of substances from the surface into well shafts; and regulates the interchange through well shafts of water between underground strata to protect and preserve the quality of underground waters.

Tulare County Code Part 4 Health, Safety and Sanitation, Chapter 15 Watercourses

The watercourses ordinance establishes standards to protect the health, safety, and welfare of Tulare County residents and property through the prevention of flooding from watercourses.

Tulare County Code Part 7 Land Use Regulation and Planning, Chapter 27 Flood Damage Prevention

The flood damage prevention ordinance establishes provisions to promote the public health, safety, and general welfare, and to minimize public and private losses due to flood conditions in specific areas. Provisions of this chapter are designed to protect human life and health; minimize the need for rescue and relief efforts associated with flooding; minimize the potential property losses in special flood hazard areas; minimize damage to public facilities and utilities in areas of special flood hazard; ensure that potential buyers are notified that a property is in an area of special flood hazard; and ensure that those who occupy the areas of special flood hazard assume responsibility for their actions.

3.3.3.10 Kern County General Plan

The policies, goals, and implementation measures in the Kern County General Plan for hydrology and water quality applicable to the project are provided below. The Kern County General Plan, originally adopted on June 15, 2004, and last amended on April 1, 2008, contains additional policies, goals, and implementation measures that are more general in nature and not specific to development such as the proposed project (Kern County Planning Department 2007). Although they are not all listed below, all policies, goals, and implementation measures in the Kern County General Plan are incorporated by reference.

Land Use, Open Space, and Conservation Element,

Section 1.3 Physical and Environmental Constraints

- Policy 1: Kern County will ensure that new developments will not be sited on land that is physically or environmentally constrained (Map Code 2.1 [Seismic Hazard], Map Code 2.2 [Landslide], Map Code 2.3 [Shallow Groundwater], Map Code 2.5 [Flood Hazard], Map Codes from 2.6–2.9, Map Code 2.10 [Nearby Waste Facility], and Map Code 2.11 [Burn Dump Hazard]) to support such development unless appropriate studies establish that such development will not result in unmitigated significant impact.

- Policy 8: Encourage the preservation of the floodplain's flow conveyance capacity, especially in floodways, to be open-space/passive recreation areas throughout the county.
- Policy 9: Construction of structures that impede water flow in a primary floodplain will be discouraged.
- Policy 10: The county will allow lands which are within flood hazard areas, other than primary floodplains, to be developed in accordance with the General Plan and Floodplain Management Ordinance, if mitigation measures are incorporated so as to ensure that the proposed development will not be hazardous within the requirements of the Safety Element (Chapter 4) of this General Plan.
- Policy 11: Protect and maintain watershed integrity within Kern County.
- Implementation Measure F: The county will comply with the Colbey-Alquist Floodplain Management Act in regulating land use within designated floodways.
- Implementation Measure H: Development within areas subject to flooding, as defined by the appropriate agency, will require necessary flood evaluations and studies.
- Implementation Measure I: Designated flood channels and water courses, such as creeks, gullies, and riverbeds, will be preserved as resource management areas or in the case of urban areas, as linear parks, whenever practicable.
- Implementation Measure J: Compliance with the Floodplain Management Ordinance prior to grading or improvement of land for development or the construction, expansion, conversion, or substantial improvements of a structure is required.
- Implementation Measure N: Applicants for new discretionary development should consult with the appropriate Resource Conservation District and the California Regional Water Quality Control Board regarding soil disturbances issues.

Section 1.9 Resource

- Policy 11: Minimize the alteration of natural drainage areas. Require development plans to include necessary mitigation to stabilize runoff and silt deposition by imposing grading and flood protection ordinances.

Section 1.10.6 Surface Water and Groundwater

- Policy 34: Ensure that water quality standards are met for existing users and future development.
- Policy 43: Drainage shall conform to the Kern County Development Standards and the Grading Ordinance.
- Policy 44: Discretionary projects shall analyze watershed impacts and mitigate for construction-related and urban pollutants, as well as alterations of flow patterns and introduction of impervious surfaces as required by CEQA, to prevent the degradation of the watershed to the extent practicable.
- Implementation Measure Y: Promote efficient water use by using measures such as:
  - Requiring water-conserving design and equipment in new construction.
  - Encouraging water-conserving landscaping and irrigation methods.
  - Encouraging the retrofitting of existing development with water-conserving devices.

3.3.3.11 Kern County Ordinances

Kern County Code Title 14 Utilities, Chapter 14.08 Water Supply Wells

The water supply wells ordinance provides standards and requirements for the design, construction, reconstruction, abandonment, and destruction of water wells.

Kern County Code Title 14 Utilities, Chapter 14.26 Stormwater Ordinance

The stormwater ordinance sets forth standards and requirements to comply with the county's NPDES permit for discharge of its municipal separate stormwater system as well as discharges regulated by an NPDES industrial permit; provides for the maximum possible beneficial public use of the county's storm drain facilities through adequate regulation of storm drain construction and storm drain use; and regulates storm drain construction, the quantity and quality of stormwater discharge, the approval of plans for storm drain constructions, and the issuance of required permits.

Kern County Code Title 17 Building and Construction, Chapter 17.48 Floodplain Management

The floodplain management ordinance restricts or prohibits uses that are dangerous to health, safety, and property loss due to water or erosion hazards, or that result in damaging increases in erosion or in flood heights or velocities; requires that uses vulnerable to floods, including facilities that serve such uses, be protected against flood damage at the time of initial construction; controls the alteration of natural floodplains, stream channels, and natural protective barriers, which help accommodate or channel flood waters; controls filling, grading, dredging, and other development that may increase flood damage; and prevents or regulates the construction of flood barriers that will unnaturally divert flood waters or that may increase flood hazards in other areas.

Kern County Code Title 19 Zoning, Chapter 19.50 Floodplain Primary District

The floodplain primary district protects public health and safety and minimizes property damage by designating areas subject to flooding with high velocities or depths and by establishing reasonable restrictions on land use in such areas; applies to areas within the "Floodway" as shown on the Flood Boundary Floodway Map or within the "Designated Floodway" as delineated by the CVFPB, formerly the State of California's Board of Reclamation; and restricts uses to those not involving buildings, structures, and other activities that have the potential to adversely affect or be adversely affected by flow of water in the floodway.

3.3.3.12 City of Fresno General Plan

The City of Fresno's General Plan (adopted February 2002) includes citywide goals and policies to address water resources and water quality (City of Fresno 2002). The *Public Facilities Element* covers stormwater drainage and flood control facilities. The objectives and policies relevant to the study area are listed below.

Public Facilities Element, Drainage, and Flood Control

E-23. Objective: Provide facilities to protect lives and property from stormwater runoff hazards.

- E-23-a. Policy: The Storm Drainage and Flood Control Master Plan of the FMFCD shall be consistent with and incorporated in the general plan including updating and revising as necessary to accommodate intensified urban uses within established areas and development within the designated North and Southeast Growth Areas. Planned stormwater drainage

basin locations are identified by the 2025 General Plan Land Use and Circulation Map (Exhibit 4), and those stormwater drainage basins not yet acquired by FMFCD have been assigned alternative land use designations, as shown on Table 6 in the plan.

- E-23-b. Policy: The City of Fresno shall continue to support and assist in the implementation of the FMFCD's Storm Drainage and Flood Control Master Plan including expansion of the District's service area boundaries to include the planned growth areas of the general plan.
- E-23-c. Policy: The City of Fresno shall coordinate with the FMFCD in updating the Flood Control Master Plan as necessary to determine the optimum locations for drainage basins and other facilities necessary to serve urban development including planned urban intensification and the planned North Growth and Southeast Growth Areas.
- E-23-d. Policy: The City of Fresno shall coordinate construction with other public and private agencies, particularly with respect to streets, sewerage, water, gas, electric, and irrigation improvements, with flood control facilities to seek the greatest public benefit at the least public cost.
- E-23-f. Policy: The City of Fresno shall encourage that, as a minimum standard, the perimeter of all permanent stormwater ponding basins be improved with a landscaped buffer.
- E-23-g. Policy: The City of Fresno shall identify and pursue all available or potential funding sources to expedite the completion of landscape amenities and recreation improvements planned or appropriate for basin sites.
- E-23-h. Policy: The City of Fresno shall pursue installation of curbing and gutters on existing developed roadways that are lacking drainage facilities.
- E-23-i. Policy: The City of Fresno shall work with the FMFCD to prevent and reduce the existence of urban stormwater pollutants to the maximum extent practicable and ensure that surface and groundwater quality, public health, and the environment will not be adversely affected by urban runoff, pursuant to the requirements of the National Pollution Discharge Elimination Systems Act.

The *Natural Resource Conservation Element – Water Resources* addresses the Fresno area's needs for adequate quantities of water suitable for human consumption, recreation, and agriculture. In conjunction with the Metropolitan Water Resources Management Plan and the 2025 General Plan Regional Cooperation and Public Facilities Elements, this Resource Conservation Element provides policy direction toward ensuring that these needs will be met in the long term (City of Fresno 2002). The objectives and policies relevant for the study area include those listed below.

G-2. Objective: Maintain a comprehensive, long-range water resources management plan that provides for appropriate management of all sources of water available to the planning area and ensure that sufficient and sustainable water supplies of good quality will be economically available to accommodate existing and planned urban development.

- G-2-a. Policy: Support cooperative, multi-agency regional water resource planning efforts involving the cities of Fresno and Clovis, Fresno County, FMFCD, the Department of Water Resources, the Regional Water Quality Control Board, irrigation districts, and other agencies and stakeholders in the area.
- G-2-b. Policy: Implement the Fresno Metropolitan Water Resources Management Plan, and update this plan as necessary, to ensure cost-effective use of water resources and continued availability of good-quality groundwater and surface water supplies.

- G-2-c. Policy: Continue interagency efforts toward completion of a Groundwater Management Plan, pursuant to the provisions added to the California Water Code by Assembly Bill 3030.
- G-2-d. Policy: Maintain and expand cooperative multi-agency planning and programs for water conservation.
- G-2-e. Policy: The conclusions, recommendations, and mitigation measures of the Metropolitan Water Resource Management Plan and its Environmental Impact Report shall be used to evaluate land use and development project proposals.

G-3. Objective: Protect water resources in the area from further degradation in quality.

- G-3-a. Policy: Monitor key water pollutants to determine directions and rates of contaminant travel, to achieve cost-effective and timely intervention for containment and remediation of contamination, and to indicate which areas may require water treatment to supply acceptable-quality drinking water.
- G-3-b. Policy: Continue to participate in interagency committees and task forces (with local, state, and federal representation, as may be needed) to share information, to efficiently use financial resources devoted to evaluating water quality problems, and to facilitate cost-effective management of water pollution.
- G-3-c. Policy: Support continued efforts to identify and mitigate detriments to surface and groundwater quality that may result from stormwater discharge from urbanized areas.
- G-3-d. Policy: Continue to implement water system policies that ensure compliance with federal and state Safe Drinking Water Standards.
- G-3-e. Policy: Support and encourage actions of the Regional Water Quality Control Board, the State Environmental Protection Agency, and the local health department to control and prevent water contamination, including leaking underground storage tank and abandoned storage tank abatement programs.
- G-3-f. Policy: Continue programs to collect and treat sewage to enhance water quality and reclaim water resources in a manner that protects the Fresno Sole Source Aquifer.
- G-3-g. Policy: Restrict urban development in areas that are not served by a wastewater treatment/management system that is capable of preventing the buildup of compounds that would degrade the aquifer. Oppose the development of new sewage disposal facilities either within the planning area or upgradient (north and east) of the planning area, unless the treatment facilities produce effluent that:
  - Will not degrade the aquifer in the long term
  - Will not introduce contaminants into surface water that would negatively affect its potential economic use for drinking water
  - Will not deleteriously affect downstream agricultural and urban uses
  - Will not degrade sensitive riparian habitat
- G-3-i. Policy: Continue to protect areas of beneficial natural groundwater recharge by preventing uses which can contaminate soil or groundwater.

G-4. Objective: Manage, use, and replenish water resources to maintain a balanced "water budget" in the Fresno area.

- G-4-a. Policy: Preserve the city's surface water entitlements to the fullest extent possible and augment surface water supplies as may be necessary.
  - Use surface water, as necessary, to balance the aquifer's long-term sustainable yield with projected demand.
  - Use surface water, as necessary, to maintain the overall high quality of Fresno's underground reservoir.
  - Protect, develop, and maintain areas and facilities necessary for groundwater recharge, including in-lieu recharge achieved through use of a surface water treatment plant.
  - Promote use of surface water for landscape irrigation when this is practicable and beneficial to overall water management objectives.
- G-4-b. Policy: In cooperation with other agencies, enhance the recharge of groundwater as may be necessary.
- G-4-c. Policy: Address localized groundwater deficiencies and groundwater quality problems that exist or may arise in portions of the planning area.

The *Safety Element – Flooding Hazard* is intended to protect lives and property from flood hazards (City of Fresno 2002). The objectives and policies that specifically deal with stormwater and flooding within the study area include those listed below.

I-5. Objective: Protect the lives and property of current and future residents of the Fresno-Clovis metropolitan area from the hazards of periodic floods. Recognize and institute adequate safeguards for the particular flooding hazards of areas on the San Joaquin river bottom and bluffs.

- I-5-a. Policy: Support the full implementation of the FMFCD's Storm Drainage and Flood Control Master Plan, the completion of planned flood control and drainage system facilities, and the continued maintenance of stormwater and floodwater retention and conveyance facilities and capacities.
- I-5-d. Policy: Ensure implementation of the FMFCD's urban drainage program, including completion of the urban storm drainage systems, to provide protection to the urban community from waters originating within the urban area.
- I-5-e. Policy: Ensure implementation of land grading and development policies that protect area residents from flooding caused by urban runoff produced by events that exceed the capacity of the Storm Drainage and Flood Control Master Plan system of facilities.

3.3.3.13 Fresno City Ordinances

Fresno Municipal Code Chapter 6 Municipal Services and Utilities, Article 4 Wells

The wells ordinance regulates the installation of wells within the city of Fresno; prohibits the drilling of wells for purposes other than furnishing water for refrigeration, air conditioning, irrigation, or monitoring; requires permits and Health Officer supervision for well drilling; and requires that drainage, supply, and monitoring wells be sealed to prevent surface water or other drainage water seepage into wells.

Fresno Municipal Code Chapter 6 Municipal Services and Utilities, Article 7 Urban Stormwater Quality Management and Discharge Control

The urban stormwater quality management and discharge control ordinance establishes regulations and requirements to ensure the health, safety, and general welfare of citizens, and protect the water quality of watercourses and water bodies pursuant to the CWA by reducing pollutants in urban stormwater discharges to the MEP and by effectively prohibiting non-stormwater discharges to the storm drain system.

Fresno Municipal Code Chapter 10 Regulations Regarding Public Nuisances and Real Property Conduct and Use, Article 9 Canals and Ponding Basins

The canals and ponding basins ordinance requires piping of irrigation or drainage canals that can be accommodated by 54-inch-inside-diameter pipe for new developments.

Fresno Municipal Code Chapter 11 Building Permits and Regulations, Article 6 Fresno Floodplain Ordinance

The Fresno floodplain ordinance restricts or prohibits uses that are dangerous to health, safety, and property due to water or erosion hazards or that result in damaging increases in erosion or in flood heights or velocities; requires that uses vulnerable to floods, including facilities that serve such uses, be protected against flood damage at the time of initial construction; controls the alteration of natural floodplains, stream channels, and natural protective barriers that help accommodate or channel floodwaters; controls such filling, grading, dredging, and other development that may increase flood damage; and prevents or regulates the construction of flood barriers that will unnaturally divert floodwaters or that may increase flood hazards in other areas.

3.3.3.14 City of Hanford General Plan

The City of Hanford General Plan provides goals and objectives regarding urban growth and development scenarios (City of Hanford 2002). Elements in the General Plan set forth objectives and policies regarding water resources that are applicable to the proposed project.

The City of Hanford Open Space, Conservation, and Recreation Element discusses the significance of water resources, particularly groundwater resources, for the well-being of the city. The General Plan establishes objectives, policies, and programs to protect water resources, encourage groundwater recharge, and maintain acceptable water quality. Objectives, policies, and programs applicable to the proposed project include those listed below.

- Objective OCR 8: Promote the conservation of water within the Hanford community.
  - Policy OCR 8.3: Explore use of alternative water sources within the Hanford Community.
- Objective OCR 9: Ensure adequate groundwater reserves are maintained for present and future domestic, commercial, and industrial uses.
  - Policy OCR 9.1: Require proponents of non-agricultural water-intensive land uses, which are determined to use more water than the previous use, to mitigate groundwater impacts.
  - Policy OCR 9.2: Protect existing groundwater recharge basins and seek the establishment of new basins within and around the city of Hanford.
  - Program OCR 9.2-A: Coordinate flood control efforts within new development to promote establishment of detention basins that enhance local groundwater recharge.

- Objective OCR 10: Ensure groundwater quality is maintained at a satisfactory level for domestic water consumption.
  - Policy OCR 10.1: Avoid degradation of groundwater reserves by domestic and industrial land uses.
  - Program OCR 10.1-A: Seek to connect unincorporated development within the urban fringe to the sewage treatment network.
  - Program OCR 10.1-B: Require proponents of industrial-oriented projects to submit proposals for water use. Encourage the reuse of water within industrial systems.

The Public Facilities and Services Element addresses impacts to water and storm drainage associated with development.

- Objective PF 8: Maintain storm drainage facilities to preserve their function and capacity.
  - Policy PF 8.1: Natural and man-made channels, detention basins, and other drainage facilities shall be maintained to ensure that their full use and carrying capacity are not impaired.
  - Policy PF 8.2: Continue to require new development to discharge stormwater runoff at volumes no greater than the capacity of any portion of the existing downstream system by using detention or retention or other approved methods, unless the project is providing drainage pursuant to an adopted drainage plan.
  - Policy PF 8.3: All drainage improvements shall comply with the City of Hanford Public Works Construction Standards.

3.3.3.15 City of Hanford Ordinances

Hanford Municipal Code Title 15 Buildings and Construction, Chapter 15.52 Flood Damage Prevention Regulation

The flood damage prevention regulation (City of Hanford 2009) restricts or prohibits uses that are dangerous to health, safety, and property due to water or erosion hazards or that result in damaging increases in erosion or in flood heights or velocities; requires that uses vulnerable to floods, including facilities that serve such uses, be protected against flood damage at the time of initial construction; controls the alteration of natural floodplains, stream channels, and natural protective barriers that help accommodate or channel floodwaters; controls such filling, grading, dredging, and other development that may increase flood damage; and prevents or regulates the construction of flood barriers that will unnaturally divert floodwaters or that may increase flood hazards in other areas.

3.3.3.16 Corcoran General Plan

The Corcoran General Plan provides a planning framework for the community's development goals and future land uses based on existing conditions (City of Corcoran 2007). Several of the General Plan elements, listed below, address objectives and policies regarding water resources that are applicable to the proposed project.

Land Use Element, Industrial Land Use

- Objective A: Promote industrial sites that are functional, have adequate public services, and have access to major streets and railroads.

- Policy 1.43: To achieve a high-quality natural environment, it shall be the policy of the city to encourage industries that demonstrate minimum air and water quality impacts and to discourage air and water quality impacts that cannot be offset.

Open Space, Conservation and Recreation Element, Natural Resources

- Objective A: Protect natural resources, including groundwater, soils, and air quality, to meet the needs of present and future generations.
- Objective B: Ensure that environmental hazards, including potential flooding and impacts from agricultural practices, are adequately addressed in the development process within the city and the Corcoran Planning Area.
- Policy 5.1: The City of Corcoran shall work cooperatively with other local agencies to expand programs that enhance groundwater recharge to maintain the groundwater supply, including the installation of retention/detention ponds in new growth areas.
- Policy 5.3: The city shall continue to participate in programs to encourage, and, in some instances to require, ongoing water conservation practices.

Public Services and Facilities Element, Public Facility Improvement

- Objective C: Facilities and services shall be consistent with the General Plan land use goals and objectives.
- Policy 8.5: Stormwater runoff drainage structures shall be designed to limit erosion.

3.3.3.17 City of Corcoran Ordinances

Corcoran Municipal Code Title 9 Building Regulations, Chapter 9 Floodplain Management Regulations

The floodplain management regulations establish provisions to promote the public health, safety, and general welfare, and to minimize public and private losses due to flood conditions in specific areas. Provisions of this chapter are designed to protect human life and health; minimize expenditure of public money for costly flood control projects; minimize the need for rescue and relief efforts associated with flooding; minimize prolonged business interruptions; minimize damage to public facilities, utilities, streets, and bridges in areas of special flood hazard; help maintain a stable tax base by providing for the sound use and development of areas of special flood hazard so as to minimize future blighted areas caused by flood damage; ensure that potential buyers are notified that property is in an area of special flood hazard; and ensure that those who occupy the areas of special flood hazard assume responsibility for their actions.

Corcoran Municipal Code Title 12 Subdivision Regulations, Chapter 1-31 Drainage Area

The drainage area regulations adopt the area within the urban improvement boundary delineated on the Land Use Element of the General Plan as one complete drainage area and require fees to defray the estimated cost of drainage facilities for the removal, transportation, and disposal of storm drain waters (City of Corcoran 2009).

3.3.3.18 City of Wasco General Plan

The city of Wasco General Plan Policies Statement is part of the General Plan Update which incorporates and addresses growth issues, opportunities, and constraints of development in the

city of Wasco (City of Wasco 2002). Policies and standards regarding development that relate to both water resources and the proposed project are listed below.

Conservation and Open Space Element, Natural Resources

- Objective A: Protect natural resources including groundwater, soils, and air quality, to meet the needs of present and future generations.
- Objective B: Ensure that environmental hazards including potential flooding and impacts from agricultural practices are adequately addressed in the development process within the city and the Wasco Planning Area.
  - Policy 1: Protect areas of natural groundwater recharge from land uses and disposal method, which would degrade groundwater quality. Promote activities, which combine stormwater control, and water recharges.
  - Policy 2: Expand programs that enhance groundwater recharge to maintain the groundwater supply, including the installation of detention ponds in new growth areas.
  - Policy 3: No urban level development shall be approved in the city unless the development is, or will be served by the city sewer system, except in the Rural Residential zone.
  - Policy 4: Water conservation methods shall be continued.
  - Policy 9: To protect human health, the city groundwater resources will be monitored on a regular basis to test for bacteriological and toxic chemical components.

Safety Element, Flooding

- Objective A: Protect the lives and property of residents from the hazards of flooding.
  - Policy 1: Consistent with federal standards, the city shall plan for storm drainage facilities sufficient to address a 100-year flood event and require adequate storm drainage facilities to prevent flooding within the community.
  - Policy 2: The city will maintain the storm drain master plan for the city, including planned growth areas and require that development conform to it.
  - Policy 3: Development proposals shall be analyzed according to the Storm Drain Collection System Study and Master Plan. Development not within an existing Master Plan watershed area may be included in the boundaries of an adjacent area and subject to a revision of facilities and cost allocation thereof.

3.3.3.19 City of Wasco Ordinances

Wasco Municipal Code Title 15 Buildings and Construction, Chapter 15.28 Drainage Area

The Wasco drainage area ordinance adopts the area within the urban improvement boundary delineated on the land use element of the general plan as one complete drainage area. It also requires fees to defray the estimated cost of drainage facilities for the removal and transportation of storm drain water (City of Wasco 2009).

Wasco Municipal Code Title 15 Buildings and Construction, Chapter 15.32 Flood Damage Prevention

The Wasco flood damage prevention ordinance restricts or prohibits uses that are dangerous to health, safety, and property due to water or erosion hazards or that result in damaging increases in erosion or in flood heights or velocities; requires that uses vulnerable to floods, including facilities that serve such uses, be protected against flood damage at the time of initial construction; controls the alteration of natural floodplains, stream channels, and natural protective barriers that help accommodate or channel floodwaters; controls such filling, grading, dredging, and other development that may increase flood damage; and prevents or regulates the construction of flood barriers that will unnaturally divert floodwaters or that may increase flood hazards in other areas.

3.3.3.20 City of Shafter Ordinances

Shafter Municipal Code Title 15 Buildings and Construction, Chapter 15.44 Floodplain Management

The city of Shafter floodplain management ordinance (City of Shafter 2009) restricts or prohibits uses that are dangerous to health, safety, and property due to water or erosion hazards or that result in damaging increases in erosion or in flood heights or velocities; requires that uses vulnerable to floods, including facilities that serve such uses, be protected against flood damage at the time of initial construction; controls the alteration of natural floodplains, stream channels, and natural protective barriers that help accommodate or channel floodwaters; controls such filling, grading, dredging, and other development that may increase flood damage; and prevents or regulates the construction of flood barriers that will unnaturally divert floodwaters or that may increase flood hazards in other areas.

3.3.3.21 Metropolitan Bakersfield General Plan/Update and EIR

The Conservation Element of the Metropolitan Bakersfield General Plan sets forth goals and policies for the planning area, including the conservation of groundwater quantities and the preservation of water quality. The policies require protection of groundwater supplies by recharge and minimization of groundwater diversions to locations outside the planning area. Support programs are planned for the conveyance of water from Kern River and from sources other than the San Joaquin Valley basin. In addition, the Conservation Element encourages prioritization of water resource usage and the implementation of water conservation measures. The Safety Element includes flooding policies that require adequate maintenance of levees along the Kern River channel, urban development to avoid encroachment of impeding Kern River flood flows, maintenance of the Kern River channel, and the implementation of a flood prevention program as relates to new development (City of Bakersfield and County of Kern 2002a).

The Metropolitan Bakersfield General Plan Update EIR sets forth goals and policies to maintain water quality and groundwater supplies as Metropolitan Bakersfield develops in accordance with the General Plan Update. The goals and policies aim at preventing further quality degradation of both groundwater and surface water by developing and maintaining groundwater recharge facilities, supplying additional water resources to the planning area, and requiring the design of land use patterns, grading, and landscaping practices to minimize soil erosion. Applicable policies also require the implementation of programs that promote water conservation, continuance of existing water sources, and water conveyance from additional sources (City of Bakersfield and County of Kern 2002b).

The Metropolitan Bakersfield General Plan (City of Bakersfield and County of Kern 2002a) includes countywide goals, policies, and implementation measures for the conservation of groundwater quantities, the preservation of water quality, and flood control (City of Bakersfield

and County of Kern 2002a.) The Draft Metropolitan Bakersfield General Plan Update (April 2009) highlights issues, challenges, and recommended changes to the General Plan (City of Bakersfield and County of Kern 2009). The policies listed below (Conservation and Safety Elements) are found in both the General Plan and General Plan Update and specifically apply to the Proposed Project.

Conservation Element, Water Resources Goals

- Conserve and augment the available water resources of the planning area.
- Ensure that adequate groundwater resources remain available to the planning area.
- Ensure that adequate surface water supplies remain available to the planning area.
- Continue cooperative planning for and implementation of programs and projects which will resolve water resource deficiencies and water quality problems.
- Achieve a continuing balance between competing demands for water resource usage.
- Maintain effective cooperative planning programs for water resource conservation and use in the planning area by involving all responsible water agencies in the planning process.

Conservation Element, Water Resources Policies

- Develop and maintain facilities for groundwater recharge in the planning area.
- Minimize the loss of water that could otherwise be used for groundwater recharge purposes and could benefit planning area groundwater aquifers from diversion to locations outside the area.
- Support programs to convey water from other San Joaquin Valley basin sources to the planning area.
- Support programs and policies which ensure continuance or augmentation of Kern River surface water supplies.
- Protect planning area groundwater resources from further water-quality degradation.
- Provide substitute or supplemental water resources to areas already impacted by groundwater-quality degradation by supporting facilities construction for surface water diversion.
- Consider each proposal for water resource usage within the context of total planning area needs and priorities—major incremental water transport, groundwater recharge, flood control, recreational needs, riparian habitat preservation, and conservation.
- Encourage and implement water conservation measures and programs.

Safety Element, Flooding Policies

- Develop specific standards that apply to development in flood hazard areas, as defined by the Flood Insurance Rate Maps and most recent information as adopted by the responsible agency.
- Maintain adequate levees along the Kern River channel throughout the planning area.

- Prevent urban development encroachment which would impede flood flows in the Kern River designated floodway.

Safety Element, Seismic Policies: Dam Failure Inundation Risk

- Design discretionary critical facilities in the potential inundation area for dam failure to mitigate the effects of inundation on the facility; promote orderly shutdown and evacuation (as appropriate); and prevent onsite hazards from affecting building occupants and the surrounding communities in the event of dam failure.
- Design discretionary critical facilities in the potential dam inundation area used for the manufacture, storage, or use of hazardous materials to prevent onsite hazards from affecting surrounding communities in the event of inundation.
- Require emergency response plans for the planning area to include specific procedures for the sequential and orderly evacuation of the potential dam inundation area.

3.3.3.22 Bakersfield Ordinances

Bakersfield Municipal Code Title 8 Health and Safety, Chapter 8.34 Industrial Stormwater

The Bakersfield industrial stormwater ordinance sets forth standards and requirements for industrial activities to comply with NPDES industrial stormwater permits and the city's NPDES permits for discharge to its municipal separate stormwater system.

Bakersfield Municipal Code Title 8 Health and Safety, Chapter 8.35 Stormwater System

The Bakersfield stormwater system ordinance prohibits illicit discharges into stormwater system, and requires compliance with permits, contracts, and orders of the public works director relative to control of discharges into, and operation of, the city's stormwater facilities and systems.

Bakersfield Municipal Code Title 8 Health and Safety, Chapter 8.70 Regulation of Wells and Water Systems

The Bakersfield regulation of wells and water systems adopts Kern County Ordinance Code G-5006, Section 14.08 for regulation of wells and water systems; and establishes City of Bakersfield authority to approve construction of water wells.

Bakersfield Municipal Code Title 15 Buildings and Construction, Chapter 15.74 Flood Damage Prevention

The Bakersfield flood damage prevention ordinance restricts or prohibits uses that are dangerous to health, safety, and property due to water or erosion hazards or that result in damaging increases in erosion or in flood heights or velocities; requires that uses vulnerable to floods, including facilities that serve such uses, be protected against flood damage at the time of initial construction; controls the alteration of natural floodplains, stream channels, and natural protective barriers that help accommodate or channel floodwaters; controls such filling, grading, dredging, and other development that may increase flood damage; and prevents or regulates the construction of flood barriers that will unnaturally divert floodwaters or that may increase flood hazards in other areas.

Bakersfield Municipal Code Title 17 Zoning, Chapter 17.42 FP-P Floodplain Primary Zone

The Bakersfield floodplain primary zone ordinance regulates uses in areas of the city that lie within natural streambeds and those portions of adjacent floodplains through which high-velocity flows are channelized during a flood to prevent loss of life, minimize property damage, and maintain satisfactory conveyance capacities of waterways.

Bakersfield Municipal Code Title 17 Zoning, Chapter 17.44 FP-S Floodplain Secondary Zone

The Bakersfield floodplain secondary zone ordinance regulates uses in areas of the city that lie within the fringe area of the floodplain (and are subject to less-severe inundation during flooding than occurs in the FP-P zone) to protect life and property from hazards and damages that may result from floodwaters.

3.3.4 Grading Codes

3.3.4.1 Fresno County Ordinance Code, Chapter 15.28 Grading and Excavation

The Fresno County grading and excavation ordinance establishes standards for grading and excavation within unincorporated Fresno County; sets forth rules and regulations to control excavation, grading, and earthwork construction, including fills and embankments; establishes the administrative procedure for issuance of permits; and provides for approval of plans and inspection of grading construction.

3.3.4.2 Tulare County Code Part 7 Land Use Regulation and Planning, Chapter 15 Building Regulations, Article 7 Excavation and Grading

The Tulare County excavation and grading ordinance establishes standards to safeguard the public, minimize hazards to property, control erosion and protect against sedimentation of watercourses, and protect the safety, use, and stability of public rights-of-way; provides regulations to control excavation, grading, and earthwork construction; and establishes procedures for issuance of grading permits.

3.3.4.3 Kern County Grading Code, Chapter 17.28

The Kern County grading code regulates grading on private property to safeguard life, limb, property, and the public welfare; sets forth rules and regulations to control excavation, grading, and earthwork construction, including fills and embankments; establishes the administrative procedure for issuance of permits; and provides for approval of plans and inspection of grading construction.

3.3.4.4 City of Shafter Municipal Code, Title 15 Buildings and Construction, Chapter 15.28 Grading Code

The City of Shafter grading code regulates grading on private property to safeguard life, limb, property, and the public welfare; sets forth rules and regulations to control excavation, grading, and earthwork construction, including fills and embankments; establishes the administrative procedure for issuance of permits; and provides for approval of plans and inspection of grading construction.

3.3.4.5 City of Bakersfield Grading Code, Section 15.05.170

The City of Bakersfield adopted Appendix J of the California Building Code that specifies grading plan and grading permit requirements.

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Section 4.0
Existing Water Resources

4.0 Existing Water Resources

The project study area for water resources extends from the city of Fresno through the counties of Fresno, Kings, Tulare, and Kern to the city of Bakersfield. The limits of the project study area are the northern end of the proposed Fresno Station tracks south to Oswell Street in east Bakersfield. The study area also covers the area generally defined by the California Aqueduct to the west and the Sierra Nevada foothills to the east.

The project study area is within California's Central Valley; specifically, within the southern portion of the San Joaquin Valley. The San Joaquin Valley is bordered by the Coast Ranges to the west, the San Emigdio and Tehachapi Mountains to the south, the Sierra Nevada to the east, and the Sacramento–San Joaquin Delta and Sacramento Valley to the north. The total drainage area of the San Joaquin Valley is approximately 34,100 square miles, and is divided into the San Joaquin River Basin and the Tulare Lake Basin (Central Valley RWQCB 2004).

The project study area is entirely within the South Valley Floor (SVF) watershed of the Tulare Lake Basin (see Figure 4-1). The SVF watershed covers approximately 8,235 square miles (ICF Jones & Stokes 2008). The watershed boundaries within the Tulare Lake Basin shown on Figure 4-1 were derived from the California Interagency Watershed Map of 1999 (CalWater 2.2.1). Updated in May 2004, CalWater 2.2.1 is the State of California's working definition of watershed boundaries, beginning with the division of the state's 101 million acres into 10 hydrologic regions. The Tulare Lake Basin hydrologic region is subdivided into 10 subwatersheds: SVF, Kings River, Kaweah River, Kern River, Southern Sierra, Grapevine, Coast Range, Fellows, Temblor Valley, and Sunflower Valley watersheds.

The Tulare Lake Basin is essentially an endorheic basin[2] that forms the terminus of Kings, Kaweah, Tule, and Kern rivers, which flow to the dry lakebeds of Tulare, Buena Vista, and Kern lakes. Its only outlet is to the north into the San Joaquin River, which only drains during periods of extreme rainfall. The entire Tulare Lake Basin covers an area of approximately 17,400 square miles (Central Valley RWQCB 2004). Much of the topography outside of the valley floor is characterized by steep river canyons and large mountains, which is typical of the Sierra Nevada and Coast Ranges. Approximately one-third of the basin is used for agriculture. Most of the agricultural land is located in the SVF watershed, which is relatively flat. Concerns related to water quality in the Tulare Lake Basin generally occur in the SVF watershed because of the agricultural operations that take place there (ICF Jones & Stokes 2008).

Prior to agricultural development, the Tulare Lake Basin was dominated by four large, shallow, and mainly temporary inland lakes (Gronberg et al. 1998). Tulare Lake was the most northerly of these lakes and was fed by Kings, Kaweah, and Tule rivers, and sometimes Kern River. This historic lakebed has a bottom elevation of 175 feet, and one natural outlet north to the San Joaquin River at an elevation of 207 feet (ICF Jones & Stokes 2008). The Tulare Lakebed is usually dry due to irrigation diversions in Kings, Kaweah, Tule, and Kern rivers. The Tulare Lakebed has been developed into a system of levees and irrigation canals to direct flooding away from farmed tracts of land. Approximately 103 miles of levees with 35-foot-wide crowns, 110-foot-wide bases, and 19-foot heights have been built in the Tulare Lakebed (USACE 1996).

Kern River once flowed south and west across the southern portion of the valley through a complex system of sloughs, creeks, ponds, and permanent wetlands and fed Buena Vista and Kern lakes. During wet years, Buena Vista Lake would overflow into northerly flowing sloughs and drain into Tulare Lake. Water evaporated in low-lying areas and formed saline-alkaline soils.

[2] An endorheic basin is a closed topographic low area with no drainage outlet.

Figure 4-1
Regional hydrologic setting

The California Aqueduct and Friant-Kern Canal are major water conveyance systems that cross through the region. The California Aqueduct is approximately 30 miles west of the alternative alignments. It was constructed in the 1970s and supplies agricultural and municipal areas in Southern California. The California Aqueduct generally runs north-south and is the major conveyance feature for the California State Water Project, which transports water from northern to southern California. The aqueduct is 444 miles long and is mostly an open, concrete-lined canal. The canal's width and depth vary along the length of the aqueduct, but the canal is generally approximately 50 feet wide and 30 feet deep.

Friant-Kern Canal transports water south from Millerton Lake, a reservoir on the San Joaquin River north of Fresno created by Friant Dam, and joins Kern River in Bakersfield. The 152-mile-long Friant-Kern Canal is east of the alternative alignments and is part of the Central Valley Project, a U.S. Bureau of Reclamation project that stores and transports water for irrigation and drinking water purposes, and protects land from flooding. The canal capacity near Millerton Lake is 5,000 cfs and decreases to 2,000 cfs in the southern portion of the valley as water is diverted for municipal, industrial, and agricultural use (ICF Jones & Stokes 2008). With the consent of the U.S. Bureau of Reclamation, Kaweah River water is occasionally pumped to the canal to relieve downstream flooding in the Tulare Lakebed. Where the canal is full or downstream demand is low, the Friant-Kern Canal may not be used for flood control purposes (USACE 1996).

4.1 Floodplains

Historically, flooding has been a natural occurrence in the valley because it is a natural drainage basin for thousands of watershed acres of Sierra Nevada (on the east) and Coast Range (on the west) foothills and mountains. However, the construction of dams, levees, and canals in the valley has changed the pattern of flooding, restricting it mainly to rivers and creeks and their adjacent floodplains. The two types of flooding that can occur in the valley are general rainfall floods occurring in the late fall and winter in the foothills and on the valley floor and snowmelt floods occurring in the late spring and early summer.

The eastern side of the Tulare Lake Basin is drained primarily by Kings, Kaweah, Tule, and Kern rivers. Small streams drain the foothills, which are usually dry except during winter and spring runoff. Historically, runoff from large storm events flowed from the foothills, terminating on the valley floor. As areas were developed, natural flow paths were altered by agricultural practices and urban development. Natural streams and creeks were modified to convey irrigation water, and flow pathways were either rerouted along property lines or road rights-of-way or obliterated completely. Natural vegetation, no longer "managed" by periodic high-discharge events, has encroached into stream channels in a manner that unnaturally impedes floodwater events, magnifying damage to adjacent properties. Over time, these changes to the waterways have resulted in a series of streams and channels that are not capable of handling large storm event flows (FMFCD 2004).

Floodplains provide floodwater storage (which reduces the risk of downstream flooding), provide habitat for native species, improve water quality by allowing sediments and other contaminants to filtrate, and can provide locations for groundwater recharge. Within most urban areas, levees and upstream dams control floods. Many rural areas, however, are subject to shallow flow or ponding, which spreads out over extensive areas. Shallow flooding occurs primarily from overflows of stream channels when flows exceed the capacity of the channels.

Although an extensive flood control system has been constructed in the region, large portions of the Tulare Lake Basin are considered to be flood hazard areas. The Tulare Lake Basin is relatively flat with broad, shallow floodplains that are either uncontained or are uncontained at higher flows due to levee overtopping. In the vicinity of the proposed alignments, a significant factor

contributing to the size of the floodplains is the existing BNSF Railway embankment, which acts as an impediment to water moving from east to west toward the Tulare Lake Basin.

The project study area has experienced several record flood events within the past 55 years. For example, record floods have caused millions of dollars of property damage in Fresno County in December 1955, January 1956, and January/February 1969. Significant street flooding and property damage also occurred in 1978, 1983, 1986, 1991, 1992, 1993, and 1995 (FMFCD 2004). In Kern County, the most severe flooding problems on Kern River result from high-intensity winter rainstorms, which generally occur from November through April. Snowmelt floods, which usually occur in the late spring and early summer, generally have a longer period of runoff and lower peak flow than rain floods. As a result, these spring events have rarely caused significant damage in the city of Bakersfield (City of Bakersfield and County of Kern 2009).

FEMA has identified SFHAs on FIRMs for all communities that participate in the NFIP. Fresno, Kings, Tulare, and Kern counties participate in this program. These FIRMs are used by state and local governments for administering floodplain management programs, enforcing building codes, and mitigating flooding losses in their communities. The floodplain information on the FIRM is based on historical data and hydrologic and hydraulic computations. The 100-year floodplain, or the areas inundated by a storm having a 1% annual chance of occurrence, is the regulatory standard used by federal, state, and local agencies. Within the study area, the SFHAs subject to the inundation by the 100-year flood include the following FEMA designations:

- Zone A: no detailed studies were performed and no BFEs were determined.
- Zone AE: BFEs were determined.
- Zone AH: flood depths are 1 to 3 feet and BFEs were determined.
- Zone AO: flood depths are 1 to 3 feet and average depth of flooding was determined.

The existing conditions with respect to floodplains are based on available data, reports, studies, and topographic and floodplain mapping. The FEMA-designated 100-year floodplain areas are identified and mapped using GIS and are based on FEMA's FIRMs for Fresno, Kings, Tulare, and Kern counties. The SFHA designations and BFE information were obtained from the FIRMs. The FIRMs have effective dates of February 18, 2009, for Fresno County; June 16, 2009, for Kings and Tulare counties; and September 26, 2008, for Kern County (FEMA 2008a, 2009a, 2009b, 2009c).

As delineated by FEMA, 100-year floodplains exist along many of the minor creeks and streams in the rural areas of the region. In urban areas and along most of the reaches of the major rivers, the 100-year floodplains generally are contained within the riverbanks. Levees and floodwalls have been constructed in urban areas, restricting the rivers' flows, many of which also are controlled by upstream dams. Throughout the rural portion of the region, the land is low-lying and subject to frequent shallow flooding.

The floodplains within the project study area are shown on Figure 4.1-1 and summarized in Table 4.1-1. Detailed floodplain studies have been conducted for Cross Creek, Deer Creek, Kern River, and areas within the city of Fresno. Other delineated floodplain areas for this corridor include Kings River, Dutch John Cut and Cole Slough, Tule River, an unnamed watercourse at the Tulare-Kern County border (County Line Creek), and Poso Creek. These flood-prone areas are generally designated as Zone A by FEMA, indicating a floodplain for which FEMA has determined approximate inundation area(s), but without detailed flow or water surface elevation information.

FEMA defines a floodway as the channel of a stream plus any adjacent floodplain area that must be kept free of encroachment so that the 100-year flood can be conveyed without a substantial increase in the BFE (e.g., less than 1 foot) (FEMA 2009j). A FEMA-designated floodway has been delineated for Cross Creek. For Kern River within the city of Bakersfield limits, FEMA did not

compute a floodway because the city has adopted the floodway designated by CVFPB, which is based on a peak flow that exceeds the 1% annual chance flood as determined by FEMA[3] (FEMA 2008c). Floodway widths and their correspondence with the FEMA-designated 100-year floodplains are summarized in Table 4.1-1.

CVFPB defines the floodway as the stream channel and as that portion of the adjoining floodplain reasonably required to provide for passage of a design flood. CVFPB further defines a designated floodway as that area between existing levees, as adopted by CVFPB or the legislature (CVFPB 2011). CVFPB-designated floodways within the project study area include Cole Slough, Dutch John Cut, Kings River, Cross Creek, and Kern River. CVFPB-designated floodways were identified using designated floodway maps, which are available on the CVFPB web site but are not digitized. The floodway maps have adoption dates of June 25, 1971, for Cole Slough, Dutch John Cut, and Kings River; June 12, 1985, for Cross Creek; and April 19, 1976, for Kern River (CVFPB 1971a, 1971b, 1971c, 1976, 1985).

DWR manages FloodSAFE California, a program to improve flood management in California, particularly as it relates to the state/federal flood protection system in the Central Valley (DWR 2008). One of the foundational objectives of the FloodSAFE program is to provide 200-year level (or greater) flood protection to all urban and urbanizing areas in the Sacramento–San Joaquin Valley by the end of 2025. Currently, the FloodSAFE program's southernmost boundary is located at the San Joaquin River, which is north of the project study area (DWR 2003a).

[3] The peak discharges for the 1% and 0.2% annual chance floods as determined by FEMA for Kern River in Bakersfield are 10,200 cfs and 28,700 cfs, respectively. The CVFPB floodway is based on a peak discharge of 15,000 cfs (FEMA 2008c).

Figure 4.1-1
Floodplains within Fresno to Bakersfield study area

Table 4.1-1
Floodplains and Floodways Crossed by the California High-Speed Train Alternatives: Fresno to Bakersfield Section

Floodplain Name or Flooding Source	County	Alternative	FEMA Special Flood-Hazard Area[a]	Approximate Length of Floodplain Crossed (miles)	Floodplain Crossing Type and Length (miles)	FEMA BFE or Depth near Crossing (feet)[b]	Approximate Length of FEMA Floodway Crossed (feet)	CVFPB Designated Floodway Width (feet)	FEMA FIRM Panel
Downtown Fresno	Fresno	BNSF Alternative	Zone AH	0.62	open cut, 0.62	El = 287 to 288	N/A	N/A	06019C2110H
North Central Canal	Fresno	BNSF Alternative	Zone A	0.02	elevated, 0.02	N/A	N/A	N/A	06019C2125H
Central Canal	Fresno	BNSF Alternative	Zone AE	0.03	at-grade, 0.03	El = 288	N/A	N/A	06019C2125H
Kings River Complex (Cole Slough/Dutch John Cut)	Fresno & Kings	BNSF Alternative	Zone A	2.60	at-grade, 2.60	N/A	N/A	180 530 400	06019C2925H, 06031C0100C
Kings River	Fresno & Kings	Hanford West Bypass 1 and Hanford West Bypass 2	Zone A	3.12	elevated, 0.55	N/A	N/A	1,540	06019C2925H, 06031C0100C
Cross Creek	Kings	BNSF Alternative	Zone A	1.43	elevated, 0.82	N/A	1,950	11,800	06031C0375C
			Zone AE	1.41	elevated, 1.41	El = 212 to 214			
		Hanford West Bypass 1	Zone A	1.10	elevated, 0.67	N/A	880	13,200	
			Zone AE	1.79	elevated, 1.71	El = 207 to 210			
		Hanford West Bypass 2	Zone A	1.48	elevated, 0.48	N/A	1,800	9,400	
			Zone AE	1.28	elevated, 1.19	El = 212			
		BNSF Alternative	Zone A	1.03	elevated, 0.37	N/A	N/A	1,900	
		Corcoran Elevated	Zone A	0.87	at-grade, 0.87	N/A		N/A	
			Zone AE	0.15	at-grade, 0.15	El = 212			
		Corcoran Bypass	Zone A	1.47	at-grade,,1.47	N/A		N/A	
			Zone AE	0.15	at-grade, 0.15	El = 212			

Table 4.1-1
Floodplains and Floodways Crossed by the California High-Speed Train Alternatives: Fresno to Bakersfield Section

Floodplain Name or Flooding Source	County	Alternative	FEMA Special Flood-Hazard Area[a]	Approximate Length of Floodplain Crossed (miles)	Floodplain Crossing Type and Length (miles)	FEMA BFE or Depth near Crossing (feet)[b]	Approximate Length of FEMA Floodway Crossed (feet)	CVFPB Designated Floodway Width (feet)	FEMA FIRM Panel
Tule River	Kings & Tulare	BNSF Alternative	Zone A	2.38	at-grade, 2.38	N/A	N/A	N/A	06031C0525C, 06017C1550E
		Corcoran Elevated	Zone A	2.38	elevated, 0.71	N/A			
		Corcoran Bypass	Zone A	2.87	elevated, 1.44	N/A			
Local Flooding (near Angiola)	Tulare	BNSF Alternative	Zone AH	1.52	at-grade, 1.52	El = 207	N/A	N/A	06107C1900E
Deer Creek[c]	Tulare	BNSF Alternative	Zone A	0.42	at-grade, 0.42	N/A	N/A	N/A	06107C1900E, 06107C2250E
			Zone AO	4.56	elevated, 1.01	Depth = 1 to 2			
		Allensworth Bypass	Zone A	0.74	at-grade, 0.74	Depth = 1			
			Zone AO	3.18	elevated, 0.86				
County Line Creeks	Tulare & Kern	BNSF Alternative	Zone A	0.75	at-grade, 0.75	N/A	N/A	N/A	06107C2275E, 06029C0200E
Poso Creek	Kern	BNSF Alternative	Zone A	1.74	at-grade, 1.74	N/A	N/A	N/A	06029C0725E, 06029C1275E
		Allensworth Bypass	Zone A	2.03	elevated, 0.83				
		Wasco-Shafter Bypass	Zone A	2.21	elevated, 0.11	N/A			
Local Flooding (City of Shafter)	Kern	BNSF Alternative	Zone AH	0.36	elevated, 0.36	El = 349	N/A	N/A	06029C1275E, 06029C1775E
			Zone AO	0.65	elevated, 0.65	Depth = 1			
Local Flooding (South of Shafter)	Kern	BNSF Alternative	Zone A	1.83	at-grade, 1.83	N/A	N/A	N/A	06029C1800E
		Wasco-Shafter Bypass	Zone A	0.81	elevated, 0.62				

Table 4.1-1
Floodplains and Floodways Crossed by the California High-Speed Train Alternatives: Fresno to Bakersfield Section

Floodplain Name or Flooding Source	County	Alternative	FEMA Special Flood-Hazard Area[a]	Approximate Length of Floodplain Crossed (miles)	Floodplain Crossing Type and Length (miles)	FEMA BFE or Depth near Crossing (feet)[b]	Approximate Length of FEMA Floodway Crossed (feet)	CVFPB Designated Floodway Width (feet)	FEMA FIRM Panel
Kern River	Kern	BNSF Alternative	Zone AE	1.63	elevated, 1.63	El = 387 to 396	N/A	1,500	06029C2277E, 06029C2281E
		Bakersfield South	Zone AE	1.11	elevated, 1.11	El = 387 to 396		1,100	
		Bakersfield Hybrid	Zone AE	1.11	elevated, 1.11	El = 387 to 396			

Sources: CVFBP 1971a, 1971b, 1971c, 1976, 1985; FEMA 2008b, 2009d, e, f

Acronyms and Abbreviations:
BFE base flood elevation
CVFPB Central Valley Flood Protection Board
El elevation
FEMA Federal Emergency Management Agency
FIRM Flood Insurance Rate Map
N/A not applicable

Notes:
[a] Special Flood-Hazard Areas or the 100-year flood designated by FEMA. In the study area, these include:
Zone A–no BFE determined
Zone AE–BFE determined
Zone AH–flood depth of 1 to 3 feet and BFE determined
Zone AO–flood depth of 1 to 3 feet and average depth determined

[b] FEMA floodplains with Zone A designation do not have BFEs determined and are indicated with N/A. For Zone AO, average depth is shown. For Zones AE and AH, the FEMA-determined BFEs within the project footprint are shown on the table.

[c] The 100-year floodplain associated with Deer Creek extends from approximately Avenue 120 to 1 mile south of Avenue 40. Most of the project footprint on the east side of the existing tracks is designated as Zone A. On the west side, zones of AH and AO are designated. A localized area of Zone AH lies between Avenue 96 and Avenue 88, with a BFE of 207 feet. Two areas of Zone AO have depths equal to 2 feet; the remainder of Zone AO has a depth equal to 1 foot.

4.2 Surface Water Hydrology

4.2.1 Climate

The climate within the project study area is semi-arid, with the valley experiencing long, hot, dry summers and relatively mild winters. Monthly average, maximum, and minimum temperature data and daily maximum and minimum temperature data based on long-term records for several weather stations are presented in Table 4.2-1. Based on these long-term records, the average annual temperature for the project study area ranges from 62.4 to 65.2 degrees Fahrenheit (°F); the minimum daily temperature ranges from 14 to 20°F; and the maximum daily temperature ranges from 112 to 116°F.

The San Joaquin Valley and Sierra Nevada foothills commonly experience winds, generally from the northwest. Winds typically blow upward in the drainage basin in the early mornings and downward toward the valley in the evenings. The valley floor often experiences fog in late November through mid-February (USACE 1996).

The project study area is characterized by long, dry summers and intermittent wet periods. Heavy rainfall and snow in the western Sierra Nevada is the major source of water in the Tulare Lake Basin (Gronberg et al. 1998). Based on the long-term records of precipitation, the average annual precipitation in the project study area ranges from approximately 6.23 to 10.94 inches (see Table 4.2-2). Over 80% of precipitation in the project study area occurs from November through April. In the Sierra Nevada, the majority of the mean annual precipitation falls as snow and ranges from 20 inches in the foothills to over 80 inches at higher elevations. The Coast Ranges west of the valley floor have annual precipitation ranging from 10 to over 20 inches (Gronberg et al. 1998).

The soils underlying the project alternatives and HMFs consist primarily of alluvial deposits of clay, silt, sand, and gravel with varying grain sizes and content. The soil types and consistencies of these deposits vary by location, depending on how they were deposited. The surface soils in the project vicinity generally have high permeability and infiltrate runoff relatively quickly.

Climate change has the potential to increase air temperatures and modify precipitation patterns in ways that would affect snowpack and runoff. Changes in the timing and amount of flow in streams could affect flooding and water supplies. As air temperatures increase, precipitation would likely fall as rain instead of snow. Heavier rains and increased runoff during winter months could increase the intensity and frequency of floods, which could damage housing, transportation, and other infrastructure. The warmer temperatures may also cause the snow that does fall and accumulate to melt faster and earlier, making it more difficult to store and use runoff in the reservoirs upstream of the study area during the dry months in California. Projections indicate that temperatures could increase by 3°F to 9°F (CNRA 2009) and the snowpack in the Sierra Nevada could be reduced by at least 25% by 2050 (Luers and Mastrandrea 2008). A recent study conducted by DWR concluded that groundwater pumping would likely increase under climate change to augment reduced surface water supplies (DWR 2009b). Due to the inland location of the study area and its elevation, predicted sea level rise due to climate change would not be expected to affect the proposed project.

DWR addresses climate change in its California Water Plan, Update 2009 (DWR 2009a). The Water Plan, which is updated every 5 years, provides a framework for water managers, legislators, and the public to consider options, make decisions, and implement adaptation strategies (e.g., operational changes for reservoirs) to ensure that Californians have an adequate water supply, reliable flood control, and healthy ecosystems.

Table 4.2-1
Temperature Summary

Temperature (°F)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Fresno, California (1948-2012)													
Mean Monthly	46.1	51.1	55.4	61.2	68.9	76.1	82	80.1	75.1	65.4	53.9	46	63.4
Average Max.	54.6	61.5	67	74.4	83.4	91.6	98.3	96.3	90.7	79.7	65.3	54.7	76.5
Average Min.	37.6	40.7	43.8	48	54.3	60.5	65.7	63.9	59.6	51.2	42.4	37.3	50.4
Daily Max. Extreme	78	80	90	100	107	110	113	112	111	102	90	77	113
Daily Min. Extreme	18	24	26	32	36	44	50	49	37	27	26	18	18
Hanford, California (1899-2012)													
Mean Monthly	44.9	50.2	54.8	60.6	68	74.8	80.2	78.2	73	63.7	52.5	45	62.2
Average Max.	54.7	61.9	67.5	74.9	83.5	91.4	97.8	96.1	90.5	80	66.2	55.4	76.7
Average Min.	35.2	38.6	42.1	46.4	52.5	58.3	62.5	60.4	55.5	47.4	38.8	34.6	47.7
Daily Max. Extreme	95	94	95	100	107	114	116	115	110	101	94	77	116
Daily Min. Extreme	14	18	23	20	30	36	44	40	35	28	18	15	14
Visalia, California (1895-2012)													
Mean Monthly	46.4	51.7	55.9	61.2	67.9	75.1	80.5	78.9	73.7	65.2	54.4	46.8	63.1
Average Max.	56	62.6	68	74.6	82.6	91.1	97.6	96.2	90.1	80.2	67.3	56.8	76.9
Average Min.	36.9	40.8	43.7	47.5	53	59	63.5	61.6	57.3	50.2	41.6	36.8	49.3
Daily Max. Extreme	80	89	90	103	108	113	115	115	110	104	94	86	115
Daily Min. Extreme	13	24	22	26	29	35	32	30	32	25	20	20	13
Corcoran, California (1948-2012)													
Mean Monthly	45.6	50.8	55.5	61.3	69	75.9	81.2	79.4	74.4	65.1	53.3	45.4	63.1
Average Max.	54.6	61.8	68.2	76	85.3	93.1	98.9	97	91.4	80.9	66	54.9	77.4
Average Min.	36.5	39.7	42.7	46.5	52.7	58.7	63.4	61.8	57.4	49.3	40.6	35.8	48.8
Daily Max. Extreme	75	81	88	100	107	114	115	112	109	105	89	79	115
Daily Min. Extreme	14	22	26	29	36	44	49	49	38	27	21	17	14
Wasco, California (1901-2012)													
Mean Monthly	45.8	50.7	55.5	61.6	69.1	76.6	82.5	80.8	74.9	65.4	53.7	46.1	63.6
Average Max.	56.8	63.2	69.1	76.6	85.1	93.6	100	98.5	91.9	81.8	68	57.7	78.5
Average Min.	34.8	38.2	42.1	46.6	53.1	59.4	64.9	63.1	57.9	49.1	39.6	34.6	48.6
Daily Max. Extreme	81	86	100	108	109	113	116	115	113	110	92	85	116
Daily Min. Extreme	12	18	20	21	27	32	46	40	21	14	17	13	12
Bakersfield, California (1937-2012)													
Mean Monthly	48	52.9	57.2	62.7	70.4	77.7	83.9	82.1	77	67.2	55.7	48.2	65.2
Average Max.	57.4	63.6	69	75.7	84.2	92.1	98.6	96.6	91	80.5	67.3	57.8	77.8
Average Min.	38.5	42.1	45.4	49.7	56.6	63.3	69.3	67.6	63	54	44.1	38.5	52.7
Daily Max. Extreme	82	87	94	101	107	114	115	112	112	103	94	83	115
Daily Min. Extreme	20	25	31	33	37	44	52	52	45	29	28	19	19

Notes:
°F = degree(s) Fahrenheit
max. = maximum
min. = minimum
Source: Western Region Climate Center 2012.

Table 4.2-2
Average Monthly Precipitation

Station	Period of Record	Elevation (feet)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Fresno	1948-2012	340	2.09	1.9	1.89	1.03	0.36	0.16	0.01	0.01	0.15	0.53	1.13	1.64	10.9
Hanford	1899-2012	250	1.59	1.52	1.48	0.77	0.26	0.09	0.01	0.01	0.16	0.39	0.84	1.24	8.37
Visalia	1895-2012	330	1.97	1.83	1.72	0.98	0.37	0.08	0.01	0.01	0.13	0.48	0.98	1.57	10.15
Corcoran	1948-2012	200	1.47	1.31	1.15	0.67	0.24	0.06	0.01	0.01	0.15	0.32	0.74	1.03	7.15
Wasco	1901-2012	350	1.2	1.76	1.22	0.68	0.27	0.08	0.01	0.02	0.12	0.33	0.6	0.92	7.21
Bakersfield	1937-2012	490	1.04	1.16	1.12	0.67	0.22	0.07	0.01	0.04	0.1	0.3	0.59	0.85	6.18

Notes:
Precipitation measured in inches.
ºF = degrees Fahrenheit
Source: Western Region Climate Center 2012.

4.2.2 Surface Water Features

As described above and shown on Figure 4-1, the project study area is entirely within the SVF watershed of the Tulare Lake Basin. Major surface water features in the Tulare Lake Basin include Kings, Kaweah, Tule, and Kern rivers. These rivers flow westward from the Sierra Nevada and provide the majority of natural surface water supply in the basin. The downstream reaches of these rivers, many of which have been altered, cross the alternative alignments within the SVF watershed. Because of storage and diversions upstream (i.e., east) of the project study area, the downstream reaches of these rivers are often dry.

Smaller streams, creeks, and canals are also present on the valley floor, some of which cross the alternative alignments. Surface water and groundwater are pumped to and from rivers, creeks, and the numerous canals that deliver irrigation water to and from agricultural fields throughout the region. The canals are packed earth or concrete-lined, and generally lack the meanders of natural streams. With the exception of the Corcoran Reservoir, no significant lakes or reservoirs are adjacent to or within the project footprint along the alternative alignments, although small farm ponds are relatively common.

The project study area crosses or is close to several water bodies. Major water bodies and canal crossings are summarized in Table 4.2-3. Major water bodies are described from north to south in this section.

Table 4.2-3
Major Water Bodies Crossed by the California High-Speed Train Alternatives: Fresno to Bakersfield Section

Water Body[a]	Type[b]	Alternative(s)	Approximate Crossing Width (feet)[c]	Crossing Method[d]
Fresno Colony Canal	C	BNSF Alternative	50	Aerial structure
North Central Canal	C	BNSF Alternative	50	Aerial structure
Central Canal	C	BNSF Alternative	100	Culvert or bridge

Table 4.2-3
Major Water Bodies Crossed by the California High-Speed Train Alternatives: Fresno to Bakersfield Section

Water Body[a]	Type[b]	Alternative(s)	Approximate Crossing Width (feet)[c]	Crossing Method[d]
American Colony Canal	C	Fresno Works–Fresno HMF	<50	Culvert or avoidance
Washington Colony Canal	C	BNSF Alternative, Fresno Works–Fresno HMF	<50	Box culvert
North Branch of Washington Colony Canal	C	Fresno Works–Fresno HMF	<50	Culvert or avoidance
South Branch of Washington Colony Canal	C	Fresno Works–Fresno HMF	<50	Culvert or avoidance
North Branch Oleander Canal	C	BNSF Alternative, Fresno Works–Fresno HMF	<50	Box culvert
Wristen Canal	C	BNSF Alternative	<50	Box culvert
Harlan Stevens Ditch	C	BNSF Alternative	<50	Box culvert
Davis Ditch	C	BNSF Alternative	<50	Box culvert
Elkhorn Ditch	C	BNSF Alternative	<50	Box culvert
Crosscut Waste	C	BNSF Alternative	<50	Box culvert
Cole Slough	I	BNSF Alternative	300	Bridge
Dutch John Cut	I	BNSF Alternative	700	Bridge
Liberty Ditch	C	Hanford West Bypass 1, Hanford West Bypass 2	<50	Box culvert
Murphy Slough	C	Hanford West Bypass 1, Hanford West Bypass 2	75	Bridge
“A” Canal	C	Hanford West Bypass 1, Hanford West Bypass 2	50	Aerial structure
Grant Canal	C	Hanford West Bypass 1, Hanford West Bypass 2	50	Aerial structure
Kings River	I	BNSF Alternative, Hanford West Bypass 1, Hanford West Bypass 2	300 to 1,625	Bridge or aerial structure
Riverside Ditch	C	BNSF Alternative, Hanford West Bypass 1, Hanford West Bypass 2	<50 to 75	Box culvert
Peoples Ditch	C	BNSF Alternative	<50	Box culvert
East Branch of Peoples Ditch	C	BNSF Alternative	125	Box culvert (canal realignment)

Table 4.2-3
Major Water Bodies Crossed by the California High-Speed Train Alternatives: Fresno to Bakersfield Section

Water Body[a]	Type[b]	Alternative(s)	Approximate Crossing Width (feet)[c]	Crossing Method[d]
Settlers Ditch	C	BNSF Alternative, Kings County–Hanford HMF Site	<50	Aerial structure, culvert, or avoidance
Hardwick Ditch	C	Hanford West Bypass 1, Hanford West Bypass 2	<50	Box culvert
Bakker Ditch	C	Hanford West Bypass 1, Hanford West Bypass 2	<50	Box culvert
Last Chance Ditch (West Main)	C	Hanford West Bypass 1, Hanford West Bypass 2	75	Box culvert (canal realignment)
Blowers Ditch	C	Hanford West Bypass 1, Hanford West Bypass 2	<50	Box culvert
Last Chance Ditch	C	Hanford West Bypass 1, Hanford West Bypass 2 (road improvements)	60	Box culvert or bridge
Lone Oak Canal	C	Hanford West Bypass 1, Hanford West Bypass 2 (road improvements)	<50	Box culvert or bridge
Peoples Ditch	C	Hanford West Bypass 1, Hanford West Bypass 2 (road improvements and alignment crossing)	<50	Box culvert or bridge
New Deal Canal/ Peoples Ditch	C	Hanford West Bypass 1, Hanford West Bypass 2	75	Box culvert (canal realignment)
Lakeside Ditch	C	BNSF Alternative, Hanford West Bypass 1, Hanford West Bypass 2	<50	Aerial structure and box culvert
Melga Canal	C	BNSF Alternative, Hanford West Bypass 1, Hanford West Bypass 2	110 or 75	Bridge, box culvert and aerial structure
Canal near Guernsey Slough	C	Hanford West Bypass 1, Hanford West Bypass 2	<50	Box culvert (canal realignment)
Arm of Guernsey Slough	I	BNSF Alternative	275	Bridge or culvert
East Branch Lakeside Ditch	C	BNSF Alternative, Hanford West Bypass 2	<50	Box culvert
Cross Creek	I	BNSF Alternative, Hanford West Bypass 1, Hanford West Bypass 2	150 to 200	Aerial structure
West Branch Lakeland Canal	C	BNSF Alternative, Corcoran Elevated, Corcoran Bypass	50	Aerial structure or culvert

Table 4.2-3
Major Water Bodies Crossed by the California High-Speed Train Alternatives: Fresno to Bakersfield Section

Water Body[a]	Type[b]	Alternative(s)	Approximate Crossing Width (feet)[c]	Crossing Method[d]
North Corcoran Ditch	C	Corcoran Elevated	<50	Aerial structure
Sweet Canal	C	BNSF Alternative, Corcoran Elevated, Corcoran Bypass	100 to 450	Aerial structure or bridge (canal realignment)
AT and SF Ax Canal	C	Corcoran Bypass	<50	Culvert
Tule River	I	BNSF Alternative, Corcoran Elevated, Corcoran Bypass	300	Bridge or aerial structure
Taylor Canal	C	BNSF Alternative	<50	Box culvert
Lakeland Canal/Homeland Canal	C	BNSF Alternative	120	Bridge (canal realignment)
Deer Creek	I	BNSF Alternative, Allensworth Bypass	140	Aerial structure
County Line Creek North	I	BNSF Alternative	<50	Culvert
County Line Creek South	I	BNSF Alternative	84	Bridge
Poso Creek	I	BNSF Alternative, Allensworth Bypass, roadway crossing	140	Bridge or aerial structure
Arvin Edison Canal	C	BNSF Alternative	100	Aerial structure
Friant-Kern Canal	C	BNSF Alternative, Bakersfield South, Bakersfield Hybrid	150	Aerial structure
Cross Valley Canal	C	BNSF Alternative, Bakersfield South, Bakersfield Hybrid	180 to 600	Aerial structure
Kern River[e]	P	BNSF Alternative, Bakersfield South, Bakersfield Hybrid	1,500	Aerial structure
Carrier Canal	C	BNSF Alternative, Bakersfield South, Bakersfield Hybrid	120 to 150	Aerial structure
Stine Canal	C	Bakersfield South	60	Aerial structure
Kern Island Canal	C	BNSF Alternative, Bakersfield South, Bakersfield Hybrid	100	Aerial structure

Table 4.2-3
Major Water Bodies Crossed by the California High-Speed Train Alternatives: Fresno to Bakersfield Section

Water Body[a]	Type[b]	Alternative(s)	Approximate Crossing Width (feet)[c]	Crossing Method[d]
East Side Canal	C	BNSF Alternative, Bakersfield South, Bakersfield Hybrid	160 to 800	Aerial structure

Notes:

[a] Features identified from review of USGS topographic maps and aerial photographs. Unnamed irrigation canals and distribution pipelines are also crossed by the alternative alignments; these features are not listed on this table.

[b] Type: B = drainage or recharge basin, C = irrigation canal, I = intermittent, P = perennial.

[c] Crossing widths subject to change once HST alternative alignments are finalized.

[d] Based on 15% Design. Crossing method is subject to change as design progresses. Water bodies are crossed by bridge or culvert when adjacent track is at-grade and are crossed by aerial structure when adjacent track is elevated.

[e] HST alternative alignments do not cross perpendicularly to Kern River; therefore, approximate crossing width is greater than the perpendicular width of Kern River.

HST = high-speed train
USGS = U.S. Geological Survey

4.2.2.1 Fresno Area

Within the city of Fresno, and as part of the local stormwater drainage program, FMFCD operates and maintains a municipal stormwater drainage system that includes storm drains, detention and retention basins, and pump stations. Approximately 163 adopted or proposed drainage basins within the city of Fresno are (or will be) used for stormwater management and groundwater recharge. Additionally, the basins are part of the flood control program within the metropolitan area of Fresno (FMFCD 2009). The project study area passes through the drainage areas of several of the drainage basins within the city. Drainage basin CE is adjacent to the footprint of the project alternatives. (See Table 4.2-4 for details on this drainage basin and other basins in the vicinity of the alternative alignments; see also Figure 4.2-1 for floodplains in Fresno) (FMFCD 2000, 2009).

In addition to drainage basins, a canal system operated and maintained by FID is within the city of Fresno and is primarily used for the distribution of irrigation water. As part of an agreement among the city of Fresno, FID, and FMFCD, the canals are also used for flood control and for transporting water to retention basins for the purpose of groundwater recharge.[4] Fresno Colony, North Central, and Central canals cross the alternative alignments as open canals or distribution pipelines within the city limits (see Figure 4.2-1). One of the drainage basins near the alternative alignments, AW1, discharges to one of these canals, the Fresno Colony Canal (FMFCD 2009).

South of the city of Fresno limits, the alternative alignments cross Harlan Stevens, Davis, and Elkhorn ditches, approximately 5 miles south of the city of Fresno in unincorporated Fresno County. These ditches are irrigation canals.

[4] Stormwater is generally not discharged from retention basins unless necessary for flood control, which allows the majority of stormwater to percolate to groundwater.

Table 4.2-4
Fresno Metropolitan Flood Control District Basins in the Vicinity of HST Alternatives

FMFCD Basin ID[a]	Approximate Distance from Alignment (feet)	Planned/ Proposed Secondary Use(s) of Basin[b]	Total Area of Basin (acres)[c]	Est. Area Available for Recharge (Typ. 75% Total)[c]	Expected Recharge Capacity (AF/yr)[c]	Status of Basin Excavation (July 2000)[c]	Currently Intertied w/FID[c]	Drainage Area Size (acres)[c]
FF	6,000	Dual purpose	42.6	32.0	3,200	Complete	Yes	1983.3
II1	5,000	Dual purpose	14.6	11.0	750	Complete	Yes	2,072.6
LL	3,500	Recharge	18.7	14	800	Incomplete	Yes	523.3
AW1	1,500	Undetermined	9.8	7.4	N/A	Incomplete	No	276
AY	1,500	Undetermined	10.4	7.8	N/A	Incomplete	No	409.5
CE	0	Undetermined	16.9	12.7	N/A	Incomplete	No	535.2

Notes:
[a] This table includes basins within or adjacent to the project footprint and basins with drainage areas crossed by the alignments. The locations and names of the basins are from the FMFCD District Services Plan (FMFCD 2009).
[b] Secondary Uses of FMFCD Basins for Recreation and Recharge (FMFCD 2000).
[c] Central Valley RWQCB, Order No. 5-01-048 (Central Valley RWQCB 2001a).
AF/yr = acre-feet per year
Central Valley RWQCB = Central Valley Regional Water Quality Control Board
FID = Fresno Irrigation District
FMFCD = Fresno Metropolitan Flood Control District
N/A = not available

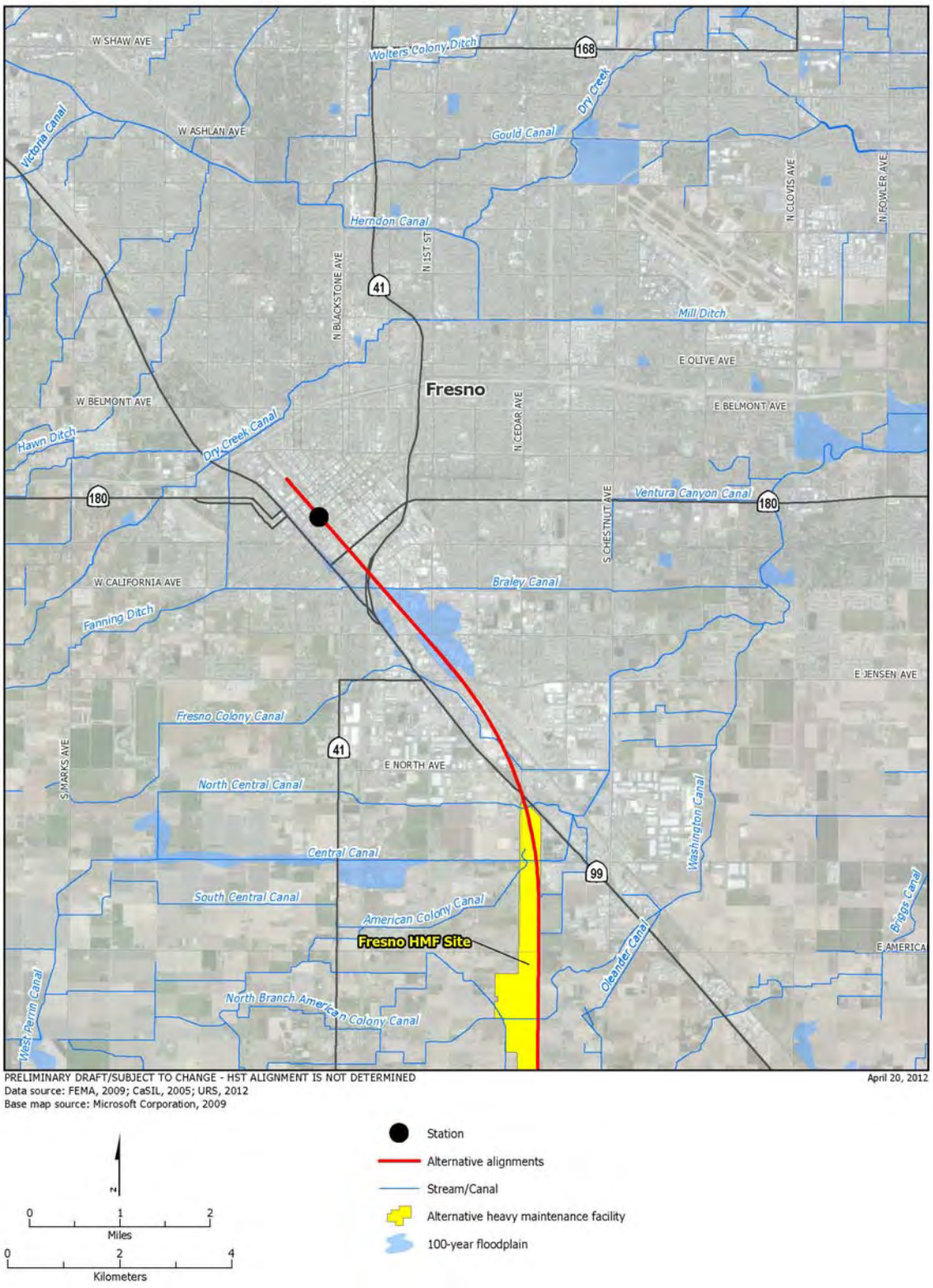


Figure 4.2-1
Floodplains in Fresno

4.2.2.2 Cole Slough

Cole Slough is the primary flow channel for Kings River from Peoples Weir, approximately 5 miles northeast of the BNSF Alternative, through northeastern Kings County to approximately 0.7 mile east of the BNSF Alternative (see Figure 4.1-1). Cole Slough was originally a small stream near Kings River but became the main course of the river after floods in 1861 and 1867 (KRCD and KRWA 2009). The original Kings River channel is now known as Old River. Cole Slough is a CVFPB-designated floodway where the BNSF Alternative crosses it near the Fresno-Kings County boundary. (See the Kings River description below for more details.)

4.2.2.3 Dutch John Cut

Dutch John Cut connects Cole Slough with Old River. Dutch John Cut was created during the 1867 flood (KRCD and KRWA 2009). Flow into Dutch John Cut is controlled by Dutch John Weir, which is approximately 0.7 mile east of the BNSF Alternative. The main flow of Kings River is through Dutch John Cut near the BNSF Alternative crossing. Flow continues downstream and eventually reaches the Tulare Lakebed.

4.2.2.4 Kings River

Kings River originates in the Sierra Nevada within the Kings River watershed and flows southwest approximately 125 miles from the foothills to the Tulare Lakebed. Elevations within the Kings River watershed range from 832 to 11,599 feet, with a mean elevation of 6,670 feet. The North, Middle, and South forks of Kings River converge in the foothills upstream of Pine Flat Dam. Pine Flat Reservoir provides 475,000 acre-feet of flood control storage (see Figure 4-1 for location of Pine Flat Reservoir). Upstream of Pine Flat Dam, Kings River drains approximately 1,545 square miles (USACE 1999). Downstream of dam, Kings River flows through canals and levee systems and splits into multiple channels as water is diverted for irrigation and flood control in the valley. As described above, Cole Slough and Dutch John Cut are part of the Kings River system.

The BNSF Alternative crosses the Kings River complex at Cole Slough, Dutch John Cut, and at the original Kings River channel (also known as Old River at this location). Within the Kings River complex, water from Kings River flows to Cole Slough and then to Dutch John Cut before it rejoins Kings River, bypassing Old River. Peoples Weir extends across Kings River approximately 1 mile downstream of State Route (SR) 99 (and 8 miles upstream of the BNSF Alternative crossing) and diverts water into the Lakeland Canal and Peoples Ditch. Cole Slough is the primary channel of the Kings River complex downstream of Peoples Weir. The main flow is again divided into Dutch John Cut and Cole Slough by Dutch John Weir about 2 miles above the BNSF Alternative crossing. The majority of the flow travels through Dutch John Cut towards Kings River. Dutch John Cut joins Kings River about 2 miles below the BNSF Alternative crossing. Flow from Kings River eventually reaches the Tulare Lakebed (KRCD and KRWA 2009).

Cole Slough rejoins Kings River at Reynolds Cut, less than 3 miles downstream of the BNSF Alternative crossing, near the town of Laton. Reynolds Weir extends across Cole Slough upstream of Reynolds Cut and controls flow into Murphy Slough, Liberty Canal, and Grant Canal. Murphy Slough flows east and connects Cole Slough to Fresno Slough near James Bypass. The Hanford West Bypass 1 Alternative and Hanford West Bypass 2 alternatives cross Murphy Slough, Grant Canal, and Kings River approximately 2 miles downstream of Reynolds Weir.

Streamflow data for Kings River collected at a gaging station downstream of Pine Flat Dam and operated by the USACE are summarized in Table 4.2-5. The river capacity is approximately 50,000 cfs downstream of Pine Flat Dam and decreases to 11,000 cfs approximately 55 miles downstream of Pine Flat Dam due to canal diversions (ICF Jones & Stokes 2008). At this location, the flow in Kings River is divided into Kings River North and Kings River South, which flow to San Joaquin River and Tulare Lakebed, respectively. Kings River North has a capacity of 4,750 cfs and

flows into Fresno Slough, which after extended wet periods, conveys water to James Bypass, approximately 30 miles east of Fresno. Water from James Bypass can flow back to Fresno Slough and then flow into Mendota Pool on the San Joaquin River. Kings River South has a channel capacity of 3,200 cfs, which is used for flood control after the Kings River North capacity has been reached (USACE 1999). Kings River South merges with Tule River Canal before entering the Tulare Lakebed. Kings River flow typically ranges from 5,000 cfs in high-flow months to 0 cfs in low-flow months (ICF Jones & Stokes 2008).

South of the Kings River crossing, the BNSF Alternative crosses Riverside Ditch approximately 0.2 mile south of Old River. The Hanford West Bypass 1 and the Hanford West Bypass 2 alternatives cross Riverside Ditch approximately 1 mile south of Kings River. Originating at Peoples Weir, Peoples Ditch conveys water southwest through the city of Hanford. The BNSF Alternative crosses Peoples Ditch approximately 3 miles northeast of Hanford, and the Hanford West Bypass 1 and Hanford West Bypass 2 alternatives cross Peoples Ditch about 2 miles south of Hanford. Last Chance Ditch conveys water southwest from Last Chance Weir, located on Kings River (or Old River) between Dutch John Cut and Reynolds Cut. The Hanford West Bypass 1 and Hanford West Bypass 2 alternatives cross the West Main of Last Chance Ditch approximately 1 mile northwest of Hanford. Last Chance and Peoples ditches are irrigation canals (see Figure 4.2-2).

Table 4.2-5
Kings River Flows, 1954 to 2012

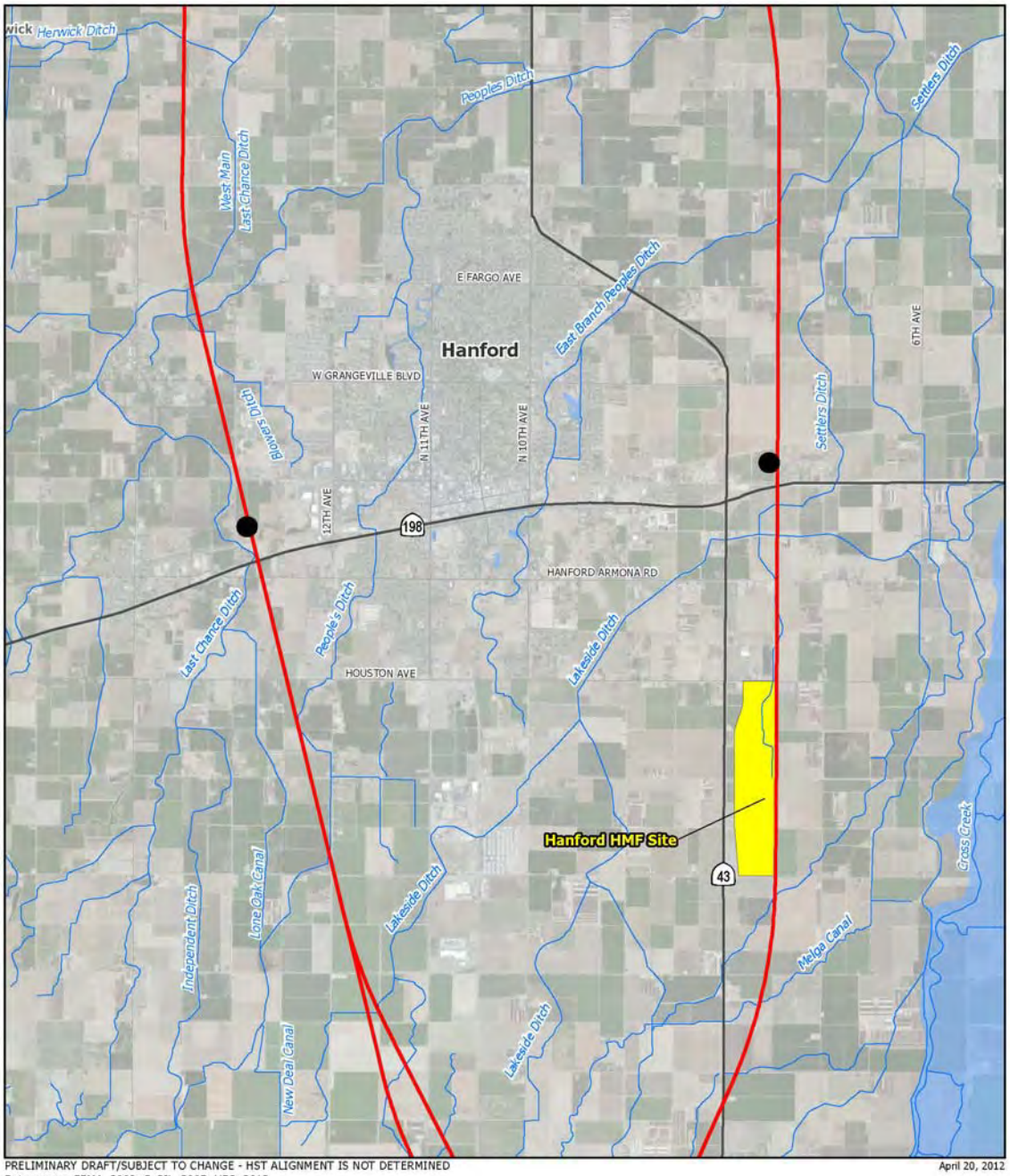
Month	USACE Gaging Station[a] Kings River Below Pine Flat Dam, CA[b] (cfs)		
	Minimum	Mean	Maximum
January	36	552	4,216
February	31	773	6,763
March	32	1,575	6,244
April	120	2,533	7,855
May	212	4,152	11,541
June	2,412	6,495	15,059
July	890	5,927	10,234
August	683	3,228	6,879
September	148	1,398	3,262
October	60	619	2,895
November	20	301	3,020
December	35	365	4,393

Notes:

[a] See Figure 4.1-1 for gaging station locations.

[b] Streamflow data are monthly mean discharges for USGS Gaging Station No. 11221500 - Kings River below Pine Flat Dam, CA and CDEC station KGF (USGS 2012a; CDEC 2012a). The drainage area above the gaging station is 1,545 square miles (USGS 2012a). The period of record is from January 1954 to May 2012.

cfs = cubic feet per second
CDEC = California Data Exchange Center
USGS = U.S. Geological Survey



PRELIMINARY DRAFT/SUBJECT TO CHANGE - HST ALIGNMENT IS NOT DETERMINED
Data source: FEMA, 2009; CaSIL, 2005; URS, 2012
Base map source: Microsoft Corporation, 2009

April 20, 2012

N

0 1 2
Miles

0 2 4
Kilometers

Station
Alternative alignments
Stream/Canal
Footprint of heavy maintenance facility (HMF)
100-year floodplain

Figure 4.2-2
Canals near Hanford

4.2.2.5 Kaweah River

Kaweah River, in Tulare County, originates in the Sierra Nevada and flows to Lake Kaweah, a reservoir formed by Terminus Dam (see Figure 4.1-1). Terminus Dam was constructed in 1961 with a 142,000-acre-foot storage capacity (USACE 1999). Elevations in the Kaweah River watershed range from 12,569 feet at the headwaters to 400 feet at the dam, with a mean elevation of 4,080 feet. The Kaweah River drainage area upstream from Terminus Dam covers approximately 561 square miles.

Streamflow data for Kaweah River collected at a gaging station downstream of Terminus Dam and operated by the USACE, are summarized in Table 4.2-6. Kaweah River flows into the San Joaquin Valley, where it is joined by Dry Creek approximately 1 mile downstream of Terminus Dam. Dry Creek drains approximately 82 square miles in the western Sierra Nevada, and ranges in elevation from 7,650 feet to 480 feet at its confluence with Kaweah River. The Kaweah River system has an average annual runoff of 442,200 acre-feet, and Dry Creek has an average annual runoff of 19,059 acre-feet (USACE 1996).

Table 4.2-6
Kaweah River Flows, 1961 to 2012

Month	USACE Gaging Station[a] Kaweah River Below Terminus Dam, CA[b] (cfs)		
	Minimum	Mean	Maximum
January	4	477	3,827
February	6	551	2,344
March	7	578	2,885
April	13	666	2,696
May	45	1,155	3,282
June	143	1,551	4,009
July	67	1,346	7,469
August	19	577	2,025
September	0.1	186	1,241
October	0	106	1,104
November	0.02	137	893
December	9	265	2,578

Notes:
[a] See Figure 4.1-1 for gaging station locations.
[b] Streamflow data are monthly mean discharges based on daily averages for USGS Gaging Station No. 11210950 - Kaweah River below Terminus Dam, CA and CDEC station KWT (USGS 2012b; CDEC 2012b). The drainage area above the gaging station is 561 square miles (USGS 2012b). The period of record is from October 1961 to May 2012.
cfs = cubic feet per second
CDEC = California Data Exchange Center
USGS = U.S. Geological Survey

St. Johns River diverges from Kaweah River 3 miles downstream of Terminus Dam at the McKay's Point Weir, where the Kaweah River drainage area covers approximately 647 square miles

(USACE 1999). Because of water management structures regulating the channel, several areas along St. Johns River have standing water during periods when no water is released from Terminus Dam. Additionally, St. Johns River receives flow from Friant-Kern Canal near Redbanks, California. St. Johns River flows westward and meets Cottonwood Creek 23 miles west of McKays Point Weir to form Cross Creek, which crosses the BNSF Alternative.

Kaweah River continues westward and divides into many smaller distributary channels with capacities ranging from approximately 9 to 700 cfs. Because much of the Kaweah River water is diverted for agricultural purposes, Kaweah River water reaches the Tulare Lakebed only under extended wet periods, including winter rain and spring snowmelt floods[5] (USACE 1996).

4.2.2.6 Cross Creek

Cross Creek, a reach of Kaweah River, is formed from the merging of Cottonwood Creek and St. Johns River in the eastern San Joaquin Valley. Cottonwood Creek flows from the foothills of the Sierra Nevada, and St. Johns River branches off Kaweah River approximately 3 miles below Terminus Dam. Cross Creek flows southwest approximately 35 miles through Tulare and Kings counties to the Tulare Lakebed. The creek is a FEMA- and CVFPB-designated floodway where it crosses the BNSF Alternative, Hanford West Bypass 1, and Hanford West Bypass 2 alternatives just north of Corcoran Reservoir and east of SR 43.

Corcoran Reservoir is located east of the alternative alignments, approximately 3 miles north of the city of Corcoran. The reservoir is operated by Corcoran Irrigation District and is used for storage and recharge. The BNSF Alternative, Hanford West Bypass 1 Alternative, and Hanford West Bypass 2 Alternative would pass adjacent to the northwest portion of Corcoran Reservoir. Corcoran Elevated and Corcoran Bypass alternatives begin near Corcoran Reservoir.

Lakeland Canal conveys water north-south and is east of the BNSF Alternative near Cross Creek and the city of Corcoran. West Branch Lakeland Canal crosses the BNSF Alternative, Corcoran Elevated, and Corcoran Bypass approximately 3 miles northwest of Corcoran.

The Corcoran Bypass Alternative crosses Sweet Canal northeast of Corcoran. The BNSF Alternative and Corcoran Elevated Alternative cross Sweet Canal at the southern city limit of Corcoran. This canal is used for distribution of irrigation water and generally runs north-south.

4.2.2.7 Tule River

As shown on Figure 4-1, the headwaters of Tule River are in the Southern Sierra watershed, along with the headwaters of Deer Creek, White River, and Poso Creek. The total drainage area of the Southern Sierra watershed is approximately 1,040 square miles (ICF Jones & Stokes 2008). Tule River originates in the Sierra Nevada and flows to Lake Success before entering the valley. The North, Middle, and South forks of Tule River converge in the foothills upstream of Lake Success. Lake Success is formed by Success Dam and has a capacity of 82,300 acre-feet. The Tule River drainage area upstream of Success Dam covers approximately 393 square miles (USACE 1999). From Lake Success, Tule River flows generally westward across the San Joaquin Valley floor to the Tulare Lakebed. The BNSF, Corcoran Elevated, and Corcoran Bypass alternatives cross Tule River approximately 3 miles south of Corcoran.

Streamflow data for Tule River collected at a U.S. Geological Survey (USGS) gaging station below Success Dam are summarized in Table 4.2-7. During summer, Tule River is often characterized

[5] Winter rain floods result from heavy precipitation and generally produce high peaks of short duration and comparatively small volumes between November and March. Spring snowmelt floods occur between March and July, and have longer durations and larger runoff volumes than winter floods.

by alternating dry and wet periods resulting from irrigation districts taking water from and discharging water to the natural channels. Friant-Kern Canal also provides flow to Tule River during summer. Tule River water that reaches the Tulare Lakebed either is stored for irrigation or evaporates (ICF Jones & Stokes 2008).

Table 4.2-7
Tule River Flows, 1960 to 1990

Month	USGS Gaging Station[a] Tule River Below Success Dam, CA[b] (cfs)		
	Minimum	Mean	Maximum
January	12	207	640
February	0.3	281	1,496
March	10	292	1,983
April	16	218	1,291
May	7	173	1,059
June	3	222	1,151
July	0	272	616
August	0	260	688
September	0	139	520
October	0	90	419
November	0.1	59	338
December	0.2	149	1,480

Notes:

[a] See Figure 4.1-1 for gaging station locations.

[b] Streamflow data are monthly mean discharges based on daily averages for USGS Gaging Station No. 11204900 – Tule River below Success Dam. The drainage area above the gaging station is 393 square miles. The period of record is from October 1960 through September 1990 (USGS 2012c).

cfs = cubic feet per second
CDEC = California Data Exchange Center
USGS = U.S. Geological Survey

4.2.2.8 Deer Creek

Deer Creek originates in the Southern Sierra watershed and flows west from the foothills of the Sierra Nevada in Tulare County. The creek is joined by Fountain Springs Gulch near Terra Bella at an elevation just below 500 feet. Streamflow data for Deer Creek collected at a USGS gaging station in the Sierra Nevada foothills are summarized in Table 4.2-8.

Deer Creek flows through the Pixley National Wildlife Refuge (NWR), which is on the valley floor east of SR 43. Deer Creek is channelized where it flows through Pixley NWR. Deer Creek crosses the BNSF Alternative and the Allensworth Bypass Alternative, and discharges to Homeland Canal approximately 2 miles west of the BNSF Alternative.

Table 4.2-8
Deer Creek Flows, 1968 to 2012

Month	USGS Gaging Station[a] Deer Creek Near Fountain Springs, CA[b] (cfs)		
	Minimum	Mean	Maximum
January	7	48	441
February	5	65	364
March	8	73	443
April	4	65	318
May	3	42	211
June	1	22	153
July	0	9	67
August	0	4	32
September	0	3	20
October	1	6	24
November	3	13	63
December	5	25	166

Notes:

[a] See Figure 4.1-1 for gaging station location.

[b] Streamflow data are monthly mean discharges based on daily averages for USGS Gaging Station No. 11200800 – Deer Creek near Fountain Springs. The drainage area above the gaging station is 83 square miles. The period of record is from September 1968 to March 2012 (USGS 2012d).

cfs = cubic feet per second
USGS = U.S. Geological Survey

4.2.2.9 White River

White River flows west from the foothills of the Sierra Nevada in the southern part of Tulare County (see Figure 4.1-1). Streamflow data for White River collected at a USGS gaging station in the Sierra Nevada foothills are summarized in Table 4.2-9. Flow gradually decreases as White River flows westward (DWR 2003b), and is generally dry by the time it reaches the valley east of the alternative alignments.

4.2.2.10 Rag Gulch

Rag Gulch flows westward from the foothills of the Sierra Nevada in northern Kern County (see Figure 4.1-1). Although generally dry by the time it reaches the alternative alignments, the flows from Rag Gulch contribute to flooding where the BNSF Alternative and the Allensworth Bypass Alternative cross the FEMA 100-year floodplain at the Tulare/Kern County border (near County Line Creek). Flows from Dyer Creek, a small stream approximately 5 miles south of Rag Gulch, also contribute to flooding.

Table 4.2-9
White River Flows, 1942 to 2005

Month	USGS Gaging Station[a] White River Near Ducor, CA (cfs)[b]		
	Minimum	Mean	Maximum
January	0.1	14	97
February	1	20	155
March	2	33	260
April	1	23	165
May	0.2	13	88
June	0	5	59
July	0	1	21
August	0	0.3	8
September	0	0.3	5
October	0	0.5	8
November	0	3	21
December	0	7	37

Note:

[a] See Figure 4.1-1 for gaging station location.

[b] Streamflow data are monthly mean discharges based on daily averages for USGS Gaging Station No. 11199500 – White River near Ducor. The drainage area above the gaging station is 91 square miles (USGS 2012e). Period of record is from October 1942 to September 2005.

cfs = cubic feet per second
USGS = U.S. Geological Survey

4.2.2.11 County Line Creek

County Line Creek is a remnant alluvial fan located near the boundary of Kern and Tulare counties. It is mapped as a special flood hazard area on the county FIRMs but has lost its connection to drainage from the hills. There is no clearly defined channel, but water draining from the area passes under the BNSF Railway though two underpasses.

4.2.2.12 Poso Creek

Poso Creek originates in the Southern Sierra watershed and flows west from the Sierra Nevada approximately 10 miles north of Bakersfield. Poso Creek receives discharge from Cawelo Water District's Reservoir B for the purpose of intentional recharge (Central Valley RWQCB 2007a). Water produced during oil operations at Poso Creek Oil Field is also discharged to Poso Creek via an unnamed ephemeral stream. The BNSF Alternative and the Allensworth Bypass Alternative cross Poso Creek approximately 4 miles north of Wasco. Poso Creek then flows to the Kern NWR (Central Valley RWQCB 2007b; SWRCB 2008), which is approximately 15 miles downstream of the alternative alignments (see Figure 4.1-1).

4.2.2.13 Kern River

Kern River headwaters are in the Sierra Nevada within the Kern River watershed. The watershed is characterized by steep river canyons and large mountains, and elevations range from 489 feet to 14,478 feet, with a mean elevation of 6,791 feet. The upper reaches of the north and south forks of Kern River are designated wild and scenic. These reaches of the river are about 60 miles east of the alternative alignments. Kern River, its forks, and Lake Isabella are the major water features within the watershed (see Figure 4.1-1) (ICF Jones & Stokes 2008). Kern River flows generally southwest through the city of Bakersfield to the Buena Vista Lakebed.

Isabella Dam was constructed in 1953 on Kern River, approximately 35 miles northeast of Bakersfield. The Kern River drainage area upstream of Isabella Dam covers approximately 2,074 square miles (USACE 1999). Lake Isabella, the reservoir created by the dam, has a capacity of approximately 570,000 acre-feet. The primary purpose of the dam and Lake Isabella is to provide flood control but also to provide water for irrigation (Gronberg et al. 1998). The dam is operated so that the maximum flow in Kern River at the Pioneer Turnout near Bakersfield does not exceed the capacity of the river channel, which is 4,600 cfs (USACE 2008b). Streamflow data for Kern River downstream of Lake Isabella collected at USGS gaging stations are summarized in Table 4.2-10.

In the valley, Kern River is bordered by conveyance and diversion canals for much of its length, and its water is diverted for consumptive use or groundwater recharge (ICF Jones & Stokes 2008). Historically, canals distributed water throughout the Bakersfield area. Beginning in the 1800s, thousands of miles of canals and laterals (i.e., small, often hand-dug canals) were constructed to drain wetlands and provide water for agricultural irrigation. By 1900, Kern River had been diverted by a series of canals constructed to serve agricultural lands throughout the southern San Joaquin Valley (Gronberg et al. 1998). Over time, portions of some of the original canals were converted to underground pipes, and others have been abandoned.

The alternative alignments cross Kern River within the city of Bakersfield, and are adjacent to several canals. The alternative alignments also cross Friant-Kern Canal within Bakersfield, in addition to various other diversion canals or distribution pipelines, including Arvin Edison Canal, Emery Ditch, Cross Valley Canal, Carrier Canal, Stine Canal, Kern Island Canal, and East Side Canal. Cross Valley Canal conveys water from the California Aqueduct eastward for agricultural purposes and westward to Bakersfield for treatment and groundwater recharge (KCWA 2004). The canal crossings are shown on Figure 4.2-3 and summarized in Table 4.2-3.

Downstream of the alternative alignments, the Kern River Intertie connects Kern River with the California Aqueduct to allow diversion of flood flows when capacity is available in the aqueduct. The intertie is downstream of the Buena Vista inlet and provides flood protection to the Tulare Lakebed (USACE 1999).

Kern River has regulated uses in accordance with the Bakersfield Zoning Code. The City of Bakersfield Planning Division has zoned Kern River and the immediately adjacent land as Floodplain Primary and Floodplain Secondary zones, respectively. Within the Floodplain Primary Zone, which includes Kern River's natural streambed, the city restricts uses that will obstruct flood flow or cause peripheral flooding of other properties. The city also regulates uses of the land adjacent to Kern River in the Floodplain Secondary Zone and requires conditional use permits for most development projects.

Kern River is on the USACE Sacramento District's list of "navigable-in-fact" traditionally navigable waters. Navigable waters of the United States are those waters that are subject to the ebb and flow of the tide and/or are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce (33 CFR Part 329.4). Although conclusive

determinations of navigability are made by federal courts, those made by federal agencies are accorded substantial weight by the courts (33 CFR Part 329.14). The other rivers crossed by the HST are not listed as navigable or navigable-in-fact.

Table 4.2-10
Kern River Flows

	USGS or USACE Gaging Station[a] (cfs)								
	Kern River near Democrat Springs, CA[b] (1950-2011)			Kern River below Kern Canyon Powerhouse near Bakersfield, CA[c] (1987-2011)			Kern River near Bakersfield, CA[d] (1950-2012)		
Month	**Min**	**Mean**	**Max**	**Min**	**Mean**	**Max**	**Min**	**Mean**	**Max**
January	154	483	2,338	50	458	1,455	173	477	2,378
February	152	599	2,439	188	567	1,753	164	574	2,197
March	221	783	3,644	331	657	2,276	228	756	3,859
April	260	1,079	5,695	369	838	2,623	274	1,033	6,366
May	256	1,503	7,613	401	1,402	4,769	273	1,418	7,071
June	311	1,961	6,850	506	1,806	4,640	325	1,873	6,297
July	400	1,764	6,110	509	1,565	3,720	410	1,640	4,292
August	216	1,297	3,824	351	1,149	3,038	198	1,207	3,906
September	127	701	2,501	26	695	1,831	116	644	2,460
October	116	521	1,835	121	432	1,484	118	470	1,667
November	127	452	1,689	142	364	1,596	135	409	1,653
December	131	407	1,432	136	375	1,485	145	390	1,341

Notes:
[a] See Figure 4.1-1 for gaging station locations.
[b] Streamflow data are monthly mean discharges based on daily averages for USGS Gaging Station No. 11192501 – Kern River near Democrat Springs (total flow). The drainage area above the gaging station is 2,258 square miles (USGS 2012f). The period of record is October 1950 to September 2011.
[c] Streamflow data are monthly mean discharges based on daily averages for USGS Gaging Station No. 11192950 – Kern River below Kern Canyon Powerhouse Diversion Dam near Bakersfield, and USGS 11192940 Kern Canyon Powerhouse near Bakersfield (USGS 2012g, 2012h). The period of record is October 1987 to September 2011.
[d] Streamflow data are monthly mean discharges for USGS 11194000 Kern River near Bakersfield, and CDEC station KRB (USGS 2012i; CDEC 2012c). The drainage area above the gaging station is 2,407 square miles (USGS 2012i). The period of record is October 1893 to May 2012.
cfs = cubic feet per second
max = maximum
min = minimum
USGS = U.S. Geological Survey

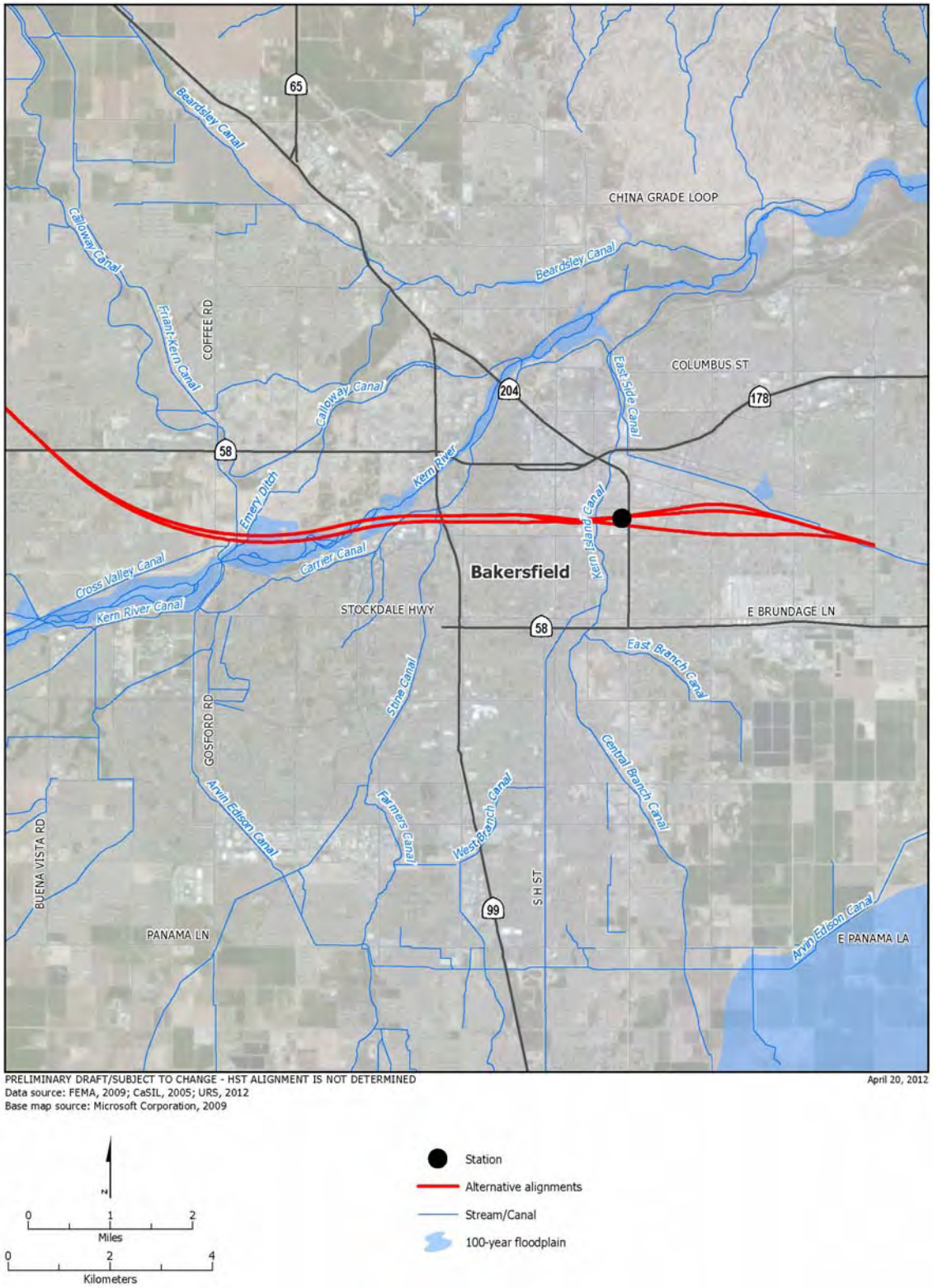


Figure 4.2-3
Floodplains in Bakersfield

4.3 Surface Water Quality

Surface water quality within the SVF watershed is influenced by agriculture. Between November and January, fields are sprayed with pesticides that can be conveyed to water bodies through stormwater runoff and agricultural return flows. Pesticides known to be associated with agricultural operations have been detected in at least one of the SVF water bodies that have been monitored. Elevated levels of arsenic, boron, cadmium, copper, iron, lead, manganese, molybdenum, selenium, and zinc have been detected at multiple locations within the SVF watershed (ICF Jones & Stokes 2008). The above metals are all naturally occurring and are partially mobilized and concentrated by irrigated agriculture. Copper and molybdenum are also used in pesticides.

The Tulare Lake Basin Plan (Central Valley RWQCB 2004) designates beneficial uses for specific surface water and groundwater resources, establishes water quality objectives to protect those uses, and sets forth policies to guide the implementation of programs to attain the objectives. The following beneficial uses are identified for natural surface waters within Tulare Lake Basin: municipal and domestic water supply; agricultural supply; industrial service supply; industrial process supply; hydropower generation; water contact recreation; non-contact water recreation; warm freshwater habitat; cold freshwater habitat; wildlife habitat; rare, threatened, or endangered species; spawning, reproduction, and/or early development; groundwater recharge; and freshwater replenishment (Central Valley RWQCB 2004). Although none of the natural streams within Tulare Lake Basin are designated for navigational use by Central Valley RWQCB, Kern River is listed as a "navigable-in-fact" by USACE. The Central Valley RWQCB has not identified beneficial uses for the canals in the area; however, canals that are connected to natural surface waters generally have the same designations as the natural feature. Table 4.3-1 summarizes the beneficial uses of water bodies in the study area.

The SWRCB developed a list of water bodies (known as 303[d] water-quality-limited water bodies) that are impaired and do not meet water quality objectives. (CWA Section 303[d] specifies the requirements for listing impaired water bodies.) A TMDL is developed for constituents on the list to restore the quality of the water body. The SWRCB develops TMDLs over several years. A few of the water bodies crossed by the alternative alignments are on the Section 303(d) list and require TMDL limits (SWRCB 2011) (see Table 4.3-1). These water bodies include Kings River, Cross Creek, and Deer Creek in the project study area, as well as Kaweah River upstream of the project study area. Kings River, Cross Creek, and Deer Creek are identified as being impaired with an unknown toxicity. The 303(d) list also includes an impairment of high pH for Deer Creek and an impairment of chlorpyrifos for Kings River in the study area (SWRCB 2011). Approximately 10 miles downstream of the alternative alignments from Island Weir to Stinson and Empire weirs, the lower portion of Kings River is identified as impaired for electrical conductivity, molybdenum, and toxaphene.

Approximately 55 miles downstream of the alternative alignment crossings, Kings River North discharges to Mendota Pool and the San Joaquin River after extended wet periods through Fresno Slough. Fresno Slough (from Graham Road to James Bypass) is identified as impaired for chlorpyrifos and unknown toxicity. Mendota Pool is identified as impaired for selenium and mercury. San Joaquin River (between Friant Dam and Mendota Pool) is identified as impaired for exotic species (SWRCB 2011).

Table 4.3-1
Surface Water Quality

Water Body[a]	Tulare Lake Basin Plan Beneficial Uses[b]														303(d) Listed Pollutants[c]
	MUN	AGR	IND	PRO	POW	REC-1	REC-2	WARM	COLD	WILD	RARE	SPWN	GWR	FRSH	
Cole Slough															
Kings River (Peoples Weir to Stinson Weir on North Fork and to Empire Weir No. 2 on South Fork)[d]		X				X	X	X		X			X		Electrical conductivity, molybdenum, toxaphene, chlorpyrifos, unknown toxicity
Cross Creek (Kaweah River, Below Lake Kaweah)	X	X	X	X		X	X	X		X			X		Unknown toxicity
Corcoran Reservoir[e]															
Tule River (Below Lake Success)	X	X	X	X		X	X	X		X			X		
Lakeland Canal/ Homeland Canal[e]															
Deer Creek															pH (high), unknown toxicity
White River															
County Line Creek															
Poso Creek		X				X	X	X	X	X			X	X	
Kern River (below Southern California Edison Kern River Powerhouse No. 1)	X	X	X	X	X	X	X	X		X	X		X		

Notes:
[a] Features identified from review of USGS topographic maps and aerial photographs.
[b] Surface water beneficial uses identified in the Tulare Lake Basin Plan (Central Valley RWQCB 2004).

MUN	=	municipal and domestic water supply	WARM	=	warm freshwater habitat
AGR	=	agricultural supply	COLD	=	cold freshwater habitat
IND	=	industrial service supply	WILD	=	wildlife habitat
PRO	=	industrial process supply	RARE	=	rare, threatened, or endangered species
POW	=	hydropower generation	SPWN	=	spawning, reproduction, and/or early development
REC-1	=	water contact recreation	GWR	=	groundwater recharge
REC-2	=	noncontact water recreation	FRSH	=	freshwater replenishment

[c] 2010 Integrated Report (CWA Section 303(d) List / 305(b) Report) (SWRCB 2011).
[d] Kings River is impaired approximately 10 miles downstream of study area (from Island Weir to Stinson and Empire Weirs). After extended wet periods, Kings River conveys water to Mendota Pool and San Joaquin River (from Friant Dam to Mendota Pool), approximately 55 miles downstream of the study area.
[e] Central Valley RWQCB has not identified beneficial uses for these man-made water features.

4.4 Erosion

Erosion is a major contributing factor to the degradation of surface water quality in the Central Valley. Silt and sand carried by stormwater runoff are the products of continuing soil erosion within the Sierra Nevada watersheds. As the topography flattens across the valley floor, soil is deposited and accumulates slowly in the channels. The accumulated material gradually decreases channel capacity and forces floodwaters increasingly farther into the surrounding floodplain. Additionally, urbanization and suburbanization create impervious surfaces that result in increased stormwater runoff and increased flow velocities that can increase the potential to erode natural stream channels. Upland erosion also causes sedimentation in the floodplains adjacent to the smaller streams and creeks, slowly decreasing their capacity to alleviate downstream flooding. According to Figure 3.14-7, Erodible Soils Statewide (North), in the Statewide Programmatic EIR/EIS (Authority and FRA 2005), the HST Fresno to Bakersfield Corridor, which includes all of the alternative alignments evaluated in this report, does not cross areas of highly erodible soils.

4.5 Groundwater

Groundwater in the region is present in unconfined or semi-confined conditions as a part of the San Joaquin Valley groundwater basin. Most of the San Joaquin Valley floor is underlain by several thousand feet of Tertiary, or older, sediments, which were deposited on a basement complex of granitic and metamorphic rocks. Water is stored in relatively coarse-grained geologic units, such as the Mehrten Formation, which have sand and gravel zones.

The project study area is within the San Joaquin Valley groundwater basin and crosses through five of its seven subbasins: Kings, Tulare Lake, Kaweah, Tule, and Kern. Table 4.5-1 summarizes the groundwater subbasins crossed by the alternative alignments and Figure 4.5-1 shows where the alternative alignments pass through those subbasins. The aquifers in these subbasins are generally thick, with wells often extending 1,000 feet below ground surface (bgs). Freshwater-bearing deposits reach their maximum thickness of 4,400 feet at the southern end of the San Joaquin Valley (DWR 2003b).

Groundwater levels fluctuate with seasonal rainfall, withdrawal, and recharge. The large demand for groundwater has caused subsidence in some areas of the valley, primarily along its western side and southern end (DWR 2003b). Depth to groundwater in the San Joaquin Valley ranges from a few inches to more than 100 feet. Groundwater levels in the project area are generally deep; most of the water depths in the project area are greater than 50 feet (see Table 4.5-2).

Groundwater is a major water supply source in the region. Groundwater is used for urban and agricultural purposes (see Table 4.5-3). Numerous large- and small-scale districts provide domestic water service to the communities and in some areas municipal supply consists entirely of groundwater. The predominant water supply source for domestic use within unincorporated communities is the individual private well system.

Groundwater in the Tulare Lake Basin may have localized impairments, which include elevated total dissolved solids (TDS), nitrate, arsenic, and organic compounds (DWR 2003b). Septic disposal systems and leach fields are potential sources of nitrate contamination in groundwater, and such uses generally must be approved at a local level, based on local soil conditions and the potential for contamination.

Table 4.5-1
Groundwater Subbasins Crossed by the California High-Speed Train Alternatives: Fresno to Bakersfield Section[a]

Groundwater Basin (Name)	Total Groundwater Basin Area (Acres)[a]	Groundwater Storage (AF)[a]	Typical Well Depths (feet)[a]	Approximate Length of Groundwater Basin Crossed (miles)[b]	Approximate Area of Groundwater Basin Crossed by HST (acres)[c]	Designated Sole-Source Aquifer[d]
Kings Subbasin	976,000	93,000,000	100 to 500	23.1 to 25.1 (BNSF Alt: 25.1)	810 to 960 (BNSF Alt: 960)	Yes
Tulare Lake Subbasin	524,000	12,100,000	150 to 2,000	18.1 to 19.9 (BNSF Alt: 19.2)	560 to 730 (BNSF Alt: 580)	No
Kaweah Subbasin	446,000	11,600,000	100 to 500	6.7 to 8.0 (BNSF Alt: 7.4)	170 to 350 (BNSF Alt: 320)	No
Tule Subbasin	467,000	9,100,000	200 to 1,400	21.2 to 22.5 (BNSF Alt: 21.9)	540 to 730 (BNSF Alt: 730)	No
Kern County Subbasin	1,945,000	40,000,000	150 to 1,200	42.3 to 44.1 (BNSF Alt: 43.2)	1,100 to 1,360 (BNSF Alt: 1,360)	No

[a] Basin areas, storage, and well depths are from Bulletin 118 (DWR 2004a, 2004b, 2006a, 2006b, 2006c).

[b] Length calculated by overlaying GIS layers for the proposed HST alternative alignments on the GIS layer for the groundwater basin. Length subject to change once HST alignment is finalized.

[c] Area calculated by overlaying GIS layers for the proposed HST permanent footprint alternatives on the GIS layer for the groundwater basin.

[d] The U.S. EPA defines a sole- or principal-source aquifer as an aquifer that supplies at least 50% of the drinking water consumed in the area overlying the aquifer. These areas may have no alternative drinking water source(s) that could physically, legally, and economically supply all those who depend on the aquifer for drinking water. For convenience, all designated sole- or principal-source aquifers are referred to as "sole-source aquifers" (SSAs).

AF = acre-feet
Alt = alternative
HST = high-speed train

Table 4.5-2
Depth to Groundwater in the Vicinity of the HST Alternatives

Groundwater Subbasin	Location	Approximate Depth to Groundwater (feet bgs)
Kings Subbasin	Fresno	50 to 100
	Laton	60
Tulare Lake Subbasin	Hanford	100 to 120
	Corcoran	110
Kaweah Subbasin	South of Hanford	100
Tule Subbasin	Pixley National Wildlife Refuge	200
Kern County Subbasin	Wasco	260
	Shafter	250 to 260
	Bakersfield	150

Source: DWR 2005
bgs = below ground surface
HST = high-speed train

Table 4.5-3
Groundwater Extraction in the Tulare Lake Hydrologic Region

Users Of Groundwater for Water Supply	Groundwater Pumping (AF/year)
Regional Groundwater Demand (Tulare Lake Hydrologic Region)	
Agricultural and Municipal groundwater use	4,340,000
Local Municipal Supply	
City of Fresno municipal supply	136,000 to 165,500
City of Hanford municipal supply	11,600 to 12,900
City of Wasco municipal supply	4,400 to 4,900
City of Bakersfield municipal supply	27,800 to 38,700
California Water Service Company's Bakersfield District municipal supply	44,000 to 53,900

Source: DWR 2003b, City of Fresno 2008, City of Hanford 2011, City of Wasco 2011, City of Bakersfield 2007, California Water Service Company 2011

AF/year = acre-feet per year
HST = high-speed train
HMF = heavy maintenance facility

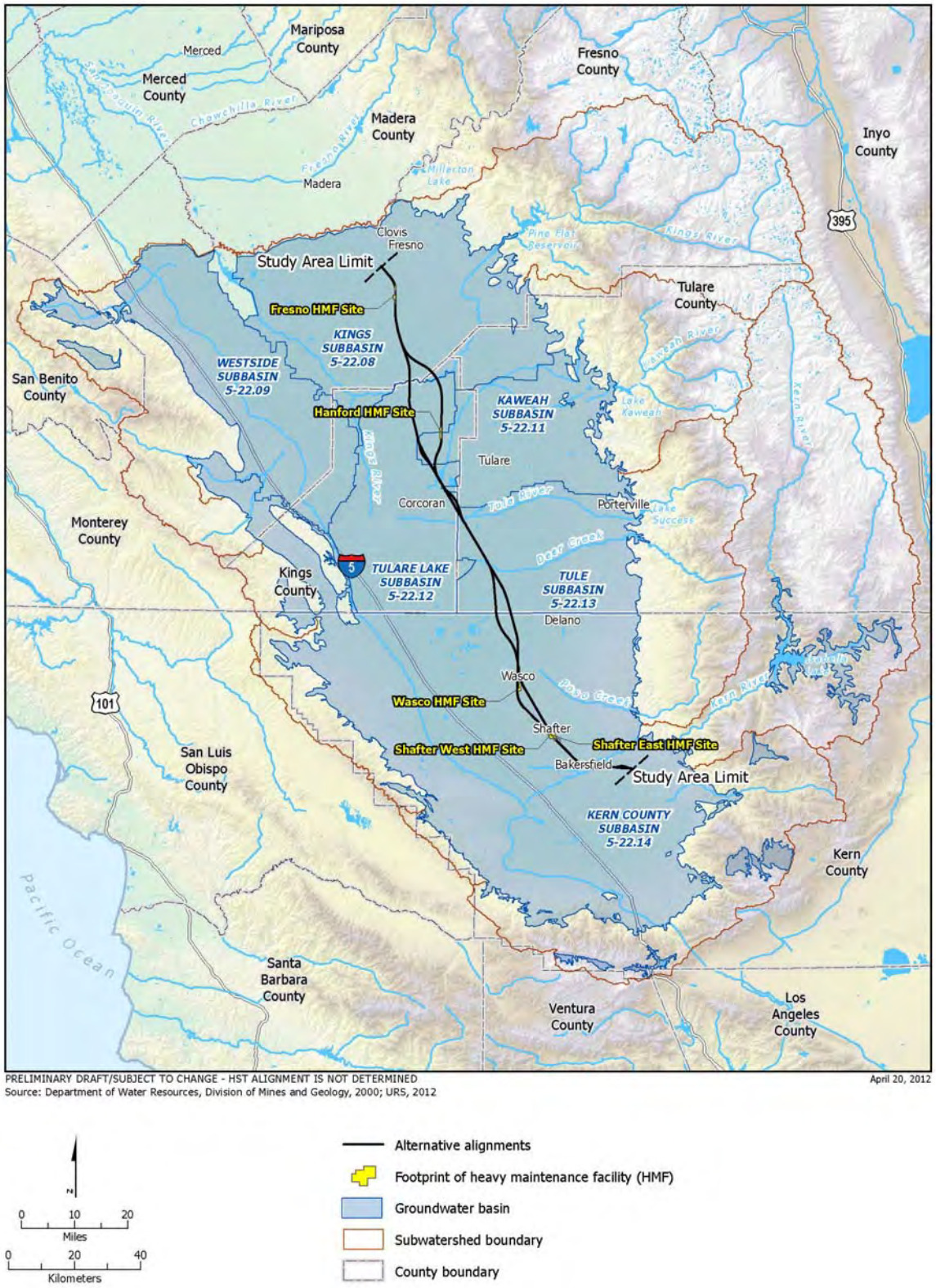


Figure 4.5-1
Groundwater basins

4.5.1 Kings Subbasin

The northern portion of the project study area is in the Kings Subbasin in the San Joaquin Valley groundwater basin. The Kings Subbasin is bounded by both natural features and irrigation district boundaries. Natural boundaries include the San Joaquin River to the north, Delta-Mendota and Westside subbasins to the west, and the Sierra Nevada foothills to the east. In Fresno, depth to groundwater ranges from approximately 90 to 150 feet bgs. In the vicinity of the alternative alignments south of the city of Fresno, depth to groundwater is approximately 60 feet bgs from Fresno to the southern boundary of the subbasin. However, depth to groundwater is as shallow as 10 feet bgs in the eastern portion of the subbasin near the Friant-Kern Canal and as deep as 190 feet bgs in the western portion of the subbasin (DWR 2005). Groundwater flows generally southwest.

Groundwater storage in the Kings Subbasin was estimated to be approximately 93,000,000 acre-feet to a depth of approximately 1,000 feet in 1961. Water levels in the subbasin have declined up to 50 feet since 1976 in response to droughts, and are currently recovering to mid-1980s levels (DWR 2006a). The Kings Subbasin benefits from groundwater recharge by river and stream seepage, deep percolation of irrigation water, canal seepage, and intentional recharge.

The City of Fresno partners with FID and FMFCD to replace lost groundwater through artificial recharge. Excess surface water is directed into the ground at Leaky Acres Groundwater Recharge Facility and at smaller facilities in southeast Fresno to replenish the underlying aquifer. Leaky Acres is a 200-acre facility that receives approximately 42 acre-feet per day for the purpose of recharging groundwater supply (City of Fresno 2009). Leaky Acres is approximately 5 miles northwest of the alternative alignments. Recharge basins within or near the study area are summarized in Table 4.2-4.

Within the project study area, the state has identified the following beneficial uses for groundwater in the subbasin: municipal and domestic supply, agricultural supply, industrial service supply, industrial process supply, and water recreation (both contact and non-contact). Groundwater in the eastern portion of the subbasin contains dibromochloropropane, a soil fumigant nematicide, and nitrates. The western portion of the Kings Subbasin contains shallow brackish groundwater. Localized areas within the Kings Subbasin contain elevated concentrations of fluoride, boron, and sodium (DWR 2006a).

The city of Fresno depends on groundwater for its water supply, and the Fresno County aquifer in Kings Subbasin is considered a U.S. EPA-designated sole-source aquifer (U.S. EPA 2009).

4.5.2 Tulare Lake Subbasin

The alternative alignments cross through Tulare Lake Subbasin, which comprises a total area of 524,000 acres, primarily in Kings County (ICF Jones & Stokes 2008). The subbasin is bounded by the Kings Subbasin to the north, the Kings-Kern county line to the south, and the Kaweah and Tule subbasins to the east. The California Aqueduct, Westside Subbasin, and Tertiary marine sediments of the Kettleman Hills make up the western boundary. Depth to groundwater is approximately 115 feet bgs near Hanford, and approximately 110 feet bgs near Corcoran (DWR 2005).

Groundwater recharge is primarily from infiltration along stream channels and from applied irrigation water. On an average annual basis, natural recharge from streams is estimated to be approximately 89,200 acre-feet per year (afy), and recharge from applied irrigation water is estimated to be approximately 195,000 afy. Storage capacity in the subbasin is estimated at approximately 17,100,000 acre-feet to a 300-foot depth, and 82,500,000 acre-feet to the base of fresh groundwater. Tulare Lake Subbasin storage was estimated at 12,100,000 acre-feet to a

depth of 300 feet in 1995, and at 37,000,000 acre-feet to depths up to 1,000 feet in 1961 (DWR 2006c).

The Tulare Lake Subbasin is not a U.S. EPA-designated or state-designated sole-source aquifer (U.S. EPA 2009; Central Valley RWQCB 2004). Within the project study area, the state has identified the following beneficial uses for groundwater in the subbasin: municipal and domestic supply, agricultural supply, industrial service supply, and industrial process supply.

The accumulation of salts in groundwater occurs as a result of the closed nature of the Tulare Lake Basin, which has minimal surface and subsurface water outflows. This problem is exacerbated by groundwater overdraft for municipal, agricultural, and industrial supplies, and by agricultural practices such as overapplying irrigation water.

Groundwater in the Tulare Lake Subbasin has typical TDS values ranging from 200 to 600 micrograms per liter. In drainage problem areas, shallow groundwater TDS values can be as high as 40,000 micrograms per liter. The southern portion of the subbasin has areas of shallow, saline groundwater and localized areas of high arsenic. Additionally, the presence of hydrogen sulfide has been reported in Hanford (DWR 2006c).

4.5.3 Kaweah Subbasin

The Kaweah Subbasin is south of the Kings Subbasin and covers approximately 446,000 acres, primarily in Tulare County, with a small area in Kings County. The Kaweah Subbasin is bounded on the north by the Kings Subbasin, on the south by the Tule Subbasin, on the west by the Tulare Lake Subbasin, and on the east by bedrock beneath the Sierra Nevada foothills. Depth to groundwater ranges from approximately 30 feet bgs in the eastern portion of the subbasin to approximately 100 feet bgs in the western portion near the proposed alignment south of Hanford (DWR 2005). Groundwater within the Kaweah Subbasin flows generally to the southwest with possible outflow westward and southward to the Tulare Lake Subbasin (ICF Jones & Stokes 2008).

Groundwater recharge in the Kaweah Subbasin is primarily from stream seepage from Sierra Nevada runoff and percolation of applied irrigation water (ICF Jones & Stokes 2008). Annual natural recharge is approximately 62,400 acre-feet. Approximately 286,000 acre-feet of applied irrigation water enters the subbasin annually. The Lakeside Irrigation District has recharged the subbasin in quantities ranging from 7,000 afy to 30,000 afy depending on the amount of precipitation received that year. Urban and agricultural groundwater extractions are estimated at 58,800 and 699,000 afy, respectively (DWR 2004a). Groundwater levels in the Kaweah Subbasin declined 12 feet from 1970 to 2000, and groundwater levels were observed to fluctuate as much as 60 feet over the 30-year period (DWR 2004a). Storage capacity in the subbasin is estimated at approximately 15,400,000 acre-feet to a depth of 300 feet and 107,000,000 acre-feet to the base of fresh groundwater (DWR 2004a).

The Kaweah Subbasin is not a U.S. EPA-designated or state-designated sole source aquifer (U.S. EPA 2009; Central Valley RWQCB 2004). Within the project study area, the state has identified the following beneficial uses for groundwater in the subbasin: municipal and domestic supply, agricultural supply, industrial service supply, industrial process supply, and water recreation (both contact and non-contact). The eastern portion of the subbasin has high concentrations of nitrates. Additionally, high-salinity groundwater has been detected east of Visalia (DWR 2004a).

4.5.4 Tule Subbasin

The alternative alignments pass over the 467,000-acre Tule Subbasin. The Tule Subbasin is in Tulare County and bounded on the north by Kaweah Subbasin, on the south by the Kern County Subbasin, on the west by the Tulare Lake Subbasin, and on the east by bedrock beneath the Sierra Nevada foothills (ICF Jones & Stokes 2008). Depth to groundwater ranges from approximately 40 feet bgs in the northeastern part of the subbasin to approximately 200 feet bgs near Pixley NWR (DWR 2005). Groundwater in the Tule Subbasin generally flows westward.

Groundwater in Tule Subbasin is extracted for urban and agricultural purposes, estimated at 19,300 and 641,000 afy, respectively. Recharge to the groundwater system occurs by stream recharge and deep percolation of applied irrigation water. Approximately 34,400 afy enters the subbasin through natural recharge, and approximately 201,000 afy enters the subbasin through applied water. According to DWR measurements, groundwater levels in the subbasin fluctuated up to 36 feet from 1970 to 2000 near the lakebed; water levels in 2000 were approximately 17 feet below 1970 levels (DWR 2004b). Storage capacity in the subbasin is estimated at approximately 14,600,000 acre-feet to a depth of 300 feet and 94,100,000 acre-feet to the base of fresh groundwater (DWR 2004b).

The Tule Subbasin is not a U.S. EPA-designated or state-designated sole source aquifer (U.S. EPA 2009; Central Valley RWQCB 2004). Within the project study area, the state has identified the following beneficial uses for groundwater in the subbasin: municipal and domestic supply, agricultural supply, industrial service supply, industrial process supply, and wildlife habitat. Groundwater in the western part of the subbasin is shallow and has elevated saline levels. High concentrations of nitrate are localized in the eastern portion of the subbasin (DWR 2004b).

4.5.5 Kern County Subbasin

The alternative alignments in Kern County overlie the Kern County Subbasin. This subbasin is bounded on the north by the Kern County line and the Tulare Lake and Tule subbasins, on the east and southeast by the granitic bedrock of the Sierra Nevada foothills and the Tehachapi Mountains, and on the southwest and west by the marine sediments of the San Emigdio Mountains and Coast Ranges. Depth to groundwater ranges from approximately 300 feet bgs to 140 feet bgs in the vicinity of the alternative alignments within the Kern County Subbasin. Depth to groundwater in Bakersfield is approximately 150 feet bgs and deeper (DWR 2005).

The Kern County Subbasin comprises an area of approximately 1,945,000 acres (ICF Jones & Stokes 2008). Recharge to the groundwater system consists of applied irrigation water and stream seepage along the eastern boundary of the subbasin and Kern River (DWR 2006b). In addition, water banking to recharge the groundwater subbasin has been used since 1978 (ICF Jones & Stokes 2008).

Several water storage districts in the Bakersfield area store or bank water in underground aquifers for future use. The alternative alignments pass through the North Kern, Rosedale-Rio Bravo, and Arvin Edison water storage districts (City of Bakersfield and County of Kern 2009). The North Kern Water Storage District uses Kern River, Poso Creek, and supplies from California State Water Project and/or the federal Central Valley Project sources (North Kern Water Storage District 2010).

The Kern Water Bank Authority recharges, stores, and recovers groundwater in the Bakersfield area. The western boundary of the approximately 20,000-acre water bank property is more than 7 miles southeast of the project study area. The Kern Water Bank, which receives water from the California Aqueduct, Kern River, and Friant-Kern Canal, can store over 1 million acre-feet of water and can recover up to 240,000 acre-feet of water per year (KWBA 2010).

The dominant recharge source in the subbasin is applied irrigation water (DWR 2006b). On a regional scale, the development of irrigated agriculture has significantly altered the groundwater flow system. Percolation of irrigation water from agricultural fields, drainage ditches, and canals has replaced infiltration of intermittent stream flow as the primary mechanism of recharge. Pumping of groundwater from wells and crop evapotranspiration have replaced natural evapotranspiration and seepage to streams in the valley trough as the primary mechanisms of discharge. Although water levels in different parts of the subbasin have varied over the last several decades, the average groundwater level in the subbasin has been relatively stable since 1970 (DWR 2006b).

The Kern County Subbasin is not a U.S. EPA–designated or state-designated sole-source aquifer (U.S. EPA 2009; Central Valley RWQCB 2004). The state has identified the following beneficial uses for groundwater in the subbasin: municipal and domestic supply, agricultural supply, and industrial service supply.

Groundwater quality in the Kern County Subbasin is considered to be generally suitable for most urban and agricultural uses with only local impairments.[6] According to the DWR, the primary constituents of concern in the region included high TDS, nitrate, arsenic, and organic compounds (DWR 2006b). The high TDS levels are generally the result of salt concentration due to evaporation and poor drainage, as well as dissolution of salts as groundwater moves through marine-derived deposits from the Coast and Temblor ranges. Nitrates may be naturally occurring or may be due to fertilizers and human or animal wastes. Elevated levels of arsenic have been reported in the Tulare Lake, Kern Lake, and Buena Vista Lakebed areas.

The quality of the groundwater along the central and eastern portions of the subbasin is considerably better than the water quality in the western portion. This is most likely due to the pronounced influence of Sierra Nevada-derived recharge to and movement of groundwater from east to west through the Kern River alluvial fan area west of Bakersfield. This condition results in a thick layer of fresh groundwater in the eastern Kern County Subbasin (DWR 2006b).

[6] Groundwater in the Etchegoin Formation and groundwater below a depth of approximately 3,000 feet bgs is not suitable for municipal or domestic supply (Central Valley RWQCB 2004).

Section 5.0
Impact Analysis

5.0 Impact Analysis

5.1 Impact Methodology

The following information sources (and associated GIS data) were used to describe the project's affected environment:

- Climate, precipitation, and topography – Sources of information for these elements included the Program EIR/EIS, California Data Exchange Center (2012a, 2012b, 2012c), Western Regional Climate Center (2012), California Irrigation Management Information System (CIMIS) (2010), USGS topographic maps, National Elevation Dataset (NED), project description and conceptual design, and project plans and profiles.

- Regional and Local Hydrology and Water Quality – The following hydrology and water quality features exist in the regional and local project vicinity: major surface water features, including lakes, reservoirs, rivers, streams, canals, and floodplains; major water quality impairments; and major groundwater aquifers. Information regarding these features and their conditions originates in the following sources: the Statewide Program EIR/EIS, USGS topographic maps, aerial imagery, FEMA FIRMs (FEMA 2008a, 2008b, 2009a, 2009b, 2009c, 2009d, 2009e, 2009f), CVFPB floodway maps (CVFPB 1971a, 1971b, 1971c, 1976, 1985), CWA Section 303(d) lists of water quality–impaired reaches (SWRCB 2011), USGS Ground Water Atlas of the United States (Planert and Williams 1995), and the National Resource Conservation Service (NRCS) Web Soil Survey (WSS) (USDA-NRCS 2010).

To evaluate potential impacts on hydrology and water resources, both quantitative and qualitative analyses were performed.

- Conceptual-level plans (15% design) for each of the project alternatives were reviewed and compared with information on existing floodplains, surface water features, and groundwater basins.

- Federal and state statutes regulating water resources were reviewed as part of the analysis of potential flooding, hydrology, and water quality impacts. The applicable statutes establish water quality standards, regulate discharges and pollution sources, and protect drinking water systems, aquifers, and floodplain and floodway values. County and city general plans and ordinances were also reviewed for applicable policies and regulations to determine if implementation of the proposed project would result in potential impacts.

- A review of available documents from various agencies, including the USGS, FEMA, CVFPB, and the RWQCB, were used to determine whether water quality and/or water resources would be impacted by the proposed project and alternatives. These documents included floodplain and floodway maps from FEMA and CVFPB. Floodplain boundaries were determined using digital FIRMs obtained from FEMA (FEMA 2008b, 2009d, 2009e, 2009f). The FEMA-designated 100-year floodplain areas and BFEs were identified and mapped using GIS, and are based on FEMA's FIRMs for Fresno, Kings, Tulare, and Kern counties. The FIRMs have effective dates of February 18, 2009, for Fresno County; June 16, 2009, for Kings and Tulare counties; and September 26, 2008, for Kern County (FEMA 2008a, 2009a, 2009b, 2009c).

Detailed topographic data were only available for a narrow part of the alignment. Detailed data were not available for wider areas of the project vicinity; therefore, information was based on available USGS topographic maps, National Elevation Dataset (NED), aerial imagery, and information from FEMA and CVFPB regarding the floodplains and floodways. The detailed data included:

- DTM DATA: These are the most detailed data. They cover a swath about 3,000 feet wide and were centered on the alignment as it existed in October 2010. They are based on photogrammetry from photographs taken on October 20 and October 26, 2010, at a scale of 1:7200. The data represent bare ground.
- Synthetic Aperture Radar (SAR) data: These data varied in location availability but were generally a swath about 12,000 feet wide covering the same path as the DTM data. They were based on published data from June 2004. The data are not bare earth but include vegetation and buildings.
- NED data: These data were used when DTM or SAR data were not available. The National Elevation Dataset is the primary elevation data product produced and distributed by the USGS. The NED is derived from diverse source data and processed to a common coordinate system and unit of vertical measure. NED data were at a 1/3 arc-second (approximately 10 meters) resolution.

The evaluation considered both direct and indirect impacts. For example, a direct effect occurs through increased turbidity and erosion during construction and increased runoff, or an increase in the BFE. An example of an indirect effect is when changes in the planned development of an area result in increased water needs or reduced water quality.

Topic-specific evaluation methods are discussed below.

5.1.1 Floodplains

The location of project facilities within a designated floodplain could expose the project to risks related to flooding, as well as subject other areas to impacts resulting from changes in the location and/or direction of flood flows.

Railroad track, bridges, and culverts that cross a designated floodplain may encroach into the floodplain and affect the hydraulics of the creek and its associated floodplain. Conceptual-level plans (15% design) for each of the project alternatives were reviewed and compared with information on existing floodplains. Portions of the HST would be constructed on grade, fill, open cut, trench, bridges, or aerial structures. Although a detailed analysis would be required to evaluate the effects of the potential encroachment, the type of crossing and the estimated amount of floodplain that may be affected by the project provides an indication of the potential magnitude of the encroachment for comparing the alternatives.

The channel of a watercourse designated as a floodway by a public agency (e.g., FEMA or CVFPB) must be kept free of encroachment so that the 100-year flood flow can be conveyed without increasing the water surface elevation. Within the portion of the floodplain outside the floodway, referred to as the floodway fringe, development and other forms of encroachment are permitted and small increases in water surface elevation may result. A substantial encroachment on the 100-year floodplain would be one that increases the base-flood elevation by 1 foot, consistent with FEMA guidance.

The evaluation of potential impacts to floodplains from the proposed HST and alternatives includes the following analyses:

- The length and acreage of floodplains defined as SFHAs within the project footprint were estimated using GIS and the proposed HST alternatives.
- The length and acreage of regulatory floodways within the project footprint were estimated using GIS.

- The distance of the nearest upstream community that could be affected by backwater effects due to floodplain encroachment was estimated.
- The potential for each alternative to increase flood height and/or divert flood flows was evaluated using flood information from the FEMA flood insurance studies and available topographic data.
- Flow data were primarily obtained from FEMA flood insurance studies from the study area. Table 5.1-1 shows the flow data available from these studies.

Table 5.1-1
Flow Data from FEMA Flood Insurance Studies

Location[a]	Flow (1% annual chance)	FIS	Notes
Central Canal at SR 99	350	Fresno County	—
Kings River upstream of Peoples Weir	19,900	Tulare County	—
East Branch Cross Creek above Tule River	19,200	Kings County	Detailed study between Orange and Kansas includes BNSF
Tule River above Cross Creek	20,500	Kings County	Detailed study at county line
Poso Creek	19,000	Kern County	Detailed study between SR 99 and Zerker Road
Kern River at Stockdale Hwy	10,200	Kern County	—

Source: FEMA 2008c, 2009g, 2009h, 2009i

[a] No information for Deer Creek.

Acronyms and Abbreviations:
FEMA = Federal Emergency Management Agency
FIS = flood insurance study
SR = state route

5.1.2 Surface Water Hydrology

Operational impacts could result from either ongoing activities of the HST System or the physical impact on the landscape by project facilities such as the track, stations, parking structures/lots, or support facilities. Conditions that could potentially lead to an impact include:

- Increases in impervious surfaces as a result of the project, leading to increases in the timing and volume of runoff.
- Changes to or interruptions in the local drainage infrastructure as a result of the proposed project design, potentially leading to localized or regional drainage impacts.

The evaluation of potential impacts to surface waters from the proposed HST and alternatives includes the following analyses:

- Analysts overlaid GIS layers for the proposed HST alternatives on the GIS layers for surface waters and flood-prone areas, USGS topographic maps, and aerial photography from web mapping services to identify the potential impacts on surface waters. Analysts then used these GIS layers to identify project crossings of streams and irrigation canals.

- The length of rivers, creeks, and canals crossed by the project footprint were estimated using GIS.
- The amount of impervious area that would be created by the HST was estimated based on the width of the track and the aerial structures.

5.1.3 Surface Water Quality

Construction activities with potential for impacts to water quality include:

- Soil-disturbing activities (e.g., excavation and grading) that can lead to erosion and sedimentation.
- Use of construction-related hazardous materials, which could result in spills that would impact surface waters.

Operational impacts could result from either ongoing activities of the HST System or the physical impact on the landscape by project facilities such as the track, stations, parking structures/lots, or support facilities. Conditions that could potentially lead to an impact include:

- Creation of substantial new sources of pollutants, such as parking lots and maintenance facilities, leading to new sources of contaminated runoff.

The evaluation of potential impacts to surface water quality from the proposed HST and alternatives includes the following analyses:

- The location of stream segments with impaired water quality in relation to the proposed HST and alternatives.
- Analysts evaluated construction activities for the potential to affect surface water quality due to uncontrolled runoff and discharges. These activities include accidental releases of construction-related hazardous materials, ground disturbance and associated erosion and sedimentation, stormwater discharges, and dewatering discharges, particularly in locations within or close to a surface water body.[7]
- Analysts reviewed project operation and maintenance activities for the potential to introduce pollutants into the environment, with a particular focus on stormwater runoff from major facilities such as the HMF and stations.

5.1.4 Groundwater

Potential impacts to groundwater resources were evaluated using documents available from DWR, Central Valley RWQCB, FMFCD, the counties, and other agencies. During construction, excavation in areas of high groundwater could potentially impact groundwater quality or quantity from dewatering activities. In general, however, depth to groundwater within the project area is typically greater than 60 feet.

The evaluation of potential impacts to groundwater from the proposed HST and alternatives includes the following analyses:

- The length and acreage of groundwater basins beneath the project footprint were estimated using GIS.

[7] An approved SWPPP, when properly implemented, would reduce the potential adverse water quality effects from construction.

- The depth to groundwater within the project study area was estimated based on available documentation from DWR.

For construction impacts, the following were evaluated:

- Potential for contaminated site runoff to percolate to groundwater.
- Excavation activities that could result in excursions below the groundwater table and provide a direct mechanism for contaminants to enter groundwater.
- Dewatering activities that could potentially deplete groundwater supplies.

For operational impacts, the following were evaluated:

- Increases in impervious surfaces as a result of the project, which could reduce groundwater recharge.
- Creation of substantial new sources of pollutants, such as parking lots and maintenance facilities, leading to new sources of contaminated runoff that could percolate to the aquifer.
- The potential for project facilities to be located below the naturally occurring water table, which could result in potential impacts to groundwater quality and/or quantity.
- The potential to affect local groundwater wells owing to the project's use of groundwater at the stations and HMF sites[8] was estimated using the Theis Equation for unsteady flow to a well (Kruseman and de Ridder 1991).

5.2 Impacts

5.2.1 Floodplains

5.2.1.1 IMPACT WTR-1: Flooding impacts associated with impeding or redirecting flood flows

The HST Fresno to Bakersfield corridor would pass through Fresno, Kings, Tulare, and Kern counties. The BNSF Alternative would stretch south from Fresno, through several small cities, including Corcoran, Wasco, and Shafter, to Bakersfield. The alignment would cross several streams and rivers, as well as a number of irrigation canals and ditches from Fresno to Bakersfield. The BNSF Alternative would also cross several extensive floodplains associated with the streams and rivers (see Table 5.2-1). The track would be on fill, on aerial structures, or on bridges at major watercourse crossings. The exact track elevations and type of support would depend on railroad grade during final design. The alternatives for specific sections along the BNSF Alternative, ranging from approximately 10 to 28 miles, are also being evaluated: Hanford West Bypass 1, Hanford West Bypass 2, Corcoran Elevated, Corcoran Bypass, Allensworth Bypass, Wasco-Shafter Bypass, Bakersfield South, and Bakersfield Hybrid alternatives. The alternatives would generally cross the same floodplains and watercourses as the BNSF Alternative, but would have varying crossing lengths (see Table 5.2-2). The alternative

[8] In general, the HST stations are located within existing or planned municipal water distribution areas while the HMF sites do not currently have connections to municipal water supply. An exception is the Kings/Tulare Regional Station – East Alternative, which is located just outside of the Hanford urban growth area. If it is not possible or practicable to connect to a municipal supply then a groundwater well (or groundwater wells) would be installed and groundwater would be used for water supply. If pumping rates are high enough, they could influence the water level in neighboring wells. Groundwater pumped at a well causes a local drawdown effect.

alignments have the potential to affect existing floodplains and watercourses. The potential impacts of the alternative alignments and the No Project Alternative are evaluated below.

Table 5.2-1
Floodplain Crossings: Fresno to Bakersfield Section

Alternative	County	Waterway	Floodplain Crossing Method[a]	Nearest Upstream Community (Approximate distance in miles)
BNSF Alternative	Fresno	No Waterway – Downtown Fresno at Church Avenue	Open cut; fill at floodplain (0.62 mile)	Fresno (0 miles)
BNSF Alternative	Fresno	North Central Canal	Elevated at floodplain (0.02 mile)	Fresno (0 miles)
BNSF Alternative	Fresno	Central Canal	Bridge at channel (0.02 mile); fill at floodplain (0.01 mile)	Fresno (0 miles)
BNSF Alternative	Fresno, Kings	Cole Slough/ Dutch John Cut/ Kings River	Bridges at channels (0.25 mile); fill at floodplain (2.35 miles)	Kingsburg (7 miles)
Hanford West Bypass 1	Fresno, Kings	Murphy Slough/ Kings River	Elevated at channels (0.55 mile); fill at floodplain (2.57 miles)	Laton (< 1 mile)
Hanford West Bypass 2	Fresno, Kings	Murphy Slough/ Kings River	Elevated at channels (0.55 mile); fill at floodplain (2.57 miles)	Laton (< 1 mile)
BNSF Alternative	Kings	Cross Creek	Elevated at channel (2.61 miles); fill at floodplain (1.28 miles)	Goshen (> 10 miles)
Hanford West Bypass 1	Kings	Cross Creek	Elevated at channel (2.38 miles); fill at floodplain (0.51 mile)	Goshen (> 10 miles)
Hanford West Bypass 2	Kings	Cross Creek	Elevated at channel (1.67 miles); fill at floodplain (1.09 miles)	Goshen (> 10 miles)
Corcoran Elevated	Kings	Cross Creek	Fill at floodplain (1.01 miles)	Goshen (> 10 miles)
Corcoran Bypass	Kings	Cross Creek	Fill at floodplain (1.62 miles)	Goshen (> 10 miles)
BNSF Alternative	Tulare	Tule River	Bridge at channel (0.06 mile); fill at floodplain (2.32 miles)	Tulare (> 10 miles)
Corcoran Elevated	Tulare	Tule River	Bridge at channel (0.06 mile); elevated at floodplain (0.71 mile); fill at floodplain (1.61 miles)	Tulare (> 10 miles)
Corcoran Bypass	Tulare	Tule River	Elevated at channel (1.44 miles); fill at floodplain (1.43 miles)	Tulare (> 10 miles)
BNSF Alternative	Tulare	No Waterway – Near Angiola	Fill at floodplain (1.52 miles)	Angiola (0 miles)

Table 5.2-1
Floodplain Crossings: Fresno to Bakersfield Section

Alternative	County	Waterway	Floodplain Crossing Method[a]	Nearest Upstream Community (Approximate distance in miles)
BNSF Alternative	Tulare	Deer Creek	Elevated at channel (1.01 miles); fill at floodplain (3.97 miles)	Earlimart (8 miles)
Allensworth Bypass	Tulare	Deer Creek	Elevated at channel (0.86 mile); fill at floodplain (3.07 miles)	Earlimart (8 miles)
BNSF Alternative	Tulare, Kern	County Line Creeks	Bridge at channel (0.02 mile); fill at floodplain (0.73 mile)	Delano (9 miles)
BNSF Alternative	Kern	Poso Creek	Bridge at channel (0.03 mile); fill at floodplain (1.71 miles)	McFarland (5 miles)
Allensworth Bypass	Kern	Poso Creek	Elevated at channel (0.83 mile); fill at floodplain (1.20 miles)	McFarland (5 miles)
Wasco-Shafter Bypass	Kern	Poso Creek	Elevated at floodplain (0.11 mile); fill at floodplain (2.11 miles)	McFarland (5 miles)
BNSF Alternative	Kern	Kern River	Elevated at floodplain (1.63 miles)	Bakersfield (0 miles)
Bakersfield South	Kern	Kern River	Elevated at floodplain (1.11 miles)	Bakersfield (0 miles)
Bakersfield Hybrid	Kern	Kern River	Elevated at floodplain (1.11 miles)	Bakersfield (0 miles)

[a] Crossing method and approximate lengths are from the 15% Design.

Table 5.2-2
Floodplains and Floodways Crossed by the Alternatives Compared with the BNSF Alternative

Alternative	Project Alternative Length through Floodplains (miles)[a]	Approximate Project Area over/in 100-Year Floodplains (acres)[a,b]	Approximate Project Area over/in FEMA Designated Floodway (acres)[a,b]	Approximate Project Area over/in CVFPB Designated Floodway (acres)[a,b]
BNSF Alternative	23.0	722	12.2	37.3
Hanford West Bypass 1, at-grade option	+0.6	+19.9	-7.0	+4.3
Hanford West Bypass 1, below-grade option	+0.6	+19.8	-7.0	+4.3
Hanford West Bypass 2, at-grade option	+0.4	-9.0	-6.9	-4.4
Hanford West Bypass 2, below-grade option	+0.4	-9.0	-6.9	-4.4
Corcoran Elevated	+0.6	-109	N/A	+0
Corcoran Bypass	+1.6	-122	N/A	+0
Allensworth Bypass	+2.6	-78.6	N/A	N/A
Wasco-Shafter Bypass	+0	-21.1	N/A	N/A
Bakersfield South	-0.5	-6.9	N/A	-0.9
Bakersfield Hybrid	-0.5	-7.1	N/A	-0.9

Notes:

[a] Values shown for the alternatives (i.e., Corcoran Elevated through Bakersfield Hybrid) represent deviations from the BNSF Alternative values.

[b] Approximate study areas in FEMA-designated 100-year floodplains (Zone A, Zone AE, Zone AH, and Zone AO) and floodways were calculated using GIS by overlaying GIS layers for the proposed HST alternative on the GIS layers for the floodplain and floodway areas. Approximate study areas in CVFPB-designated floodways were calculated by multiplying the floodway crossing length by an assumed alignment corridor width of 100 feet.

CVFPB = Central Valley Flood Protection Board
GIS = Geographic Information System
HST = high-speed train
N/A = not applicable, because alternative does not cross a FEMA- or CVFPB-designated floodway.

FEMA-designated 100-year floodplains have been identified at several locations within the project area and are generally shallow, fairly extensive, and cover a large portion of the project area. Redirecting or impeding flood flows has the potential to redefine flood hazard areas and cause flooding in areas previously not at risk to the 100-year flood. Existing agriculture or structures could be flooded as a result of redirected flood flows. In addition to agriculture, redirected flood flows also have the potential to affect other floodplain values such as conservation of existing flora and fauna, archeological sites, natural beauty, and open space.

The proposed project would cross several floodplains, as discussed under Section 4.1. The topography in the Central Valley is generally flat, and the floodplains are extensive, each covering large areas (see Figure 4.1-1). The floodplains in the project area are generally shallow, with depths ranging from less than 1 foot to approximately 3 feet, where detailed analyses have been conducted by FEMA. Although detailed analyses have not been conducted for all floodplains crossed, the 100-year floodplains throughout the project area are expected to be shallow, with average depths of 3 feet or less, due to the generally flat topography of the study area. Not all of the FEMA-designated floodplains convey concentrated flow. Some of the floodplains appear to be local depressions that fill with surface runoff during extreme events due to inadequate local drainage systems. Floodplains within the study area are summarized in Tables 4.1-1 and 5.2-1.

The proposed project would also cross FEMA- and CVFPB-designated floodways. The floodway is the portion of the floodplain that is the channel of a river or watercourse that conveys the flood waters. As such, encroachment into a floodway has the highest potential to impede, retard, or change the direction of the flow of water. A FEMA-designated floodway has been delineated for Cross Creek. CVFPB-designated floodways within the project study area include Cole Slough, Dutch John Cut, Kings River, Cross Creek, and Kern River. Within the city of Bakersfield boundaries, FEMA has adopted the CVFPB-designated floodway for Kern River.

The HST track would be built on fill, below-grade, with the support of retaining walls, on an aerial structure, or on a bridge structure to raise the track to the desired elevation. Although the majority of the alignment would be at-grade, the BNSF Alternative would include elevated structures in all of the four counties through which it travels. In floodplains, these elevated structures would be above the 100-year flood level to allow passage of flood flows (see Table 4.1-1 for floodplain crossing types and lengths). Elevated sections of the HST would be elevated up to 90 feet above existing grade.

In Fresno County, an elevated structure would carry the BNSF Alternative over Golden State Boulevard and SR 99, and a second structure would cross over the BNSF Railway tracks in the vicinity of East Conejo Avenue. The alignment would be at-grade, with bridges where it crosses Cole Slough, Dutch John Cut and Kings River into Kings County. In Kings County, the BNSF Alternative would be elevated east of Hanford, where the alignment would pass over the San Joaquin Valley Railroad and SR 198. The alignment would also be elevated over Cross Creek and the BNSF Railway right-of-way, and again starting in the central portion of Corcoran to avoid a BNSF Railway spur. In Tulare County, the BNSF Alternative would be elevated at the Tule River crossing and at the crossing of the Alpaugh railroad spur that runs west from the BNSF Railway mainline. The BNSF Alternative would be elevated in Kern County at the cities of Wasco and Shafter and across Kern River, continuing through Bakersfield.

Similarly, the bypass alternatives would generally be at-grade, but would also include elevated structures. The Hanford West Bypass 1 would be elevated when crossing over Kings River and Murphy Slough as it is passes the community of Laton to the west and again when traveling over Cross Creek north of Corcoran. The Hanford West Bypass 2 Alternative would have elevated sections similar to the Hanford West Bypass 1 Alternative but it would include an elevated section over the BNSF Railway right-of-way between Kent Avenue and Kansas Avenue north of Cross Creek. The Corcoran Elevated Alternative would pass through Corcoran on the eastern side of the BNSF Railway right-of-way on an aerial structure that extends past Tule River. Corcoran Bypass has one elevated structure which would carry the HST over SR 43, the BNSF Railway, and Tule River. The Allensworth Bypass would be constructed on an elevated structure where the alignment crosses Deer Creek and the Stoil railroad spur. This HST crossing would be elevated over Poso Creek and the BNSF Railway if the alignment connects to the Wasco-Shafter Bypass. The Wasco Shafter Bypass would be elevated where it travels over 7th Standard Road and the BNSF Railway to rejoin the BNSF Alternative. As with the BNSF Alternative, the Bakersfield South

and Bakersfield Hybrid alternatives would be elevated over Kern River and through Bakersfield to its terminus at Oswell Street.

The project design features and general design concepts for the proposed HST and its alternative alignments include, but are not limited to, the following:

- The crossing would be designed to pass 100-year flood flows without increasing water surface elevations in FEMA-designated floodways, without increasing flood elevations by more than amounts specified by CVFPB in CVFPB-designated floodways, and without increasing flood elevations by more than 1 foot in the FEMA-designated floodplains.
- HST track on embankment or retained fill would be elevated above the expected 100-year flood levels, as calculated from available flow data and FEMA BFEs, where they have been determined, to prevent saturation and infiltration of stormwater into the sub-ballast. HST tracks set below-grade would have conveyance systems to pass floodwater from one side of the trench to the other.
- Culverts or structures would be located at existing streams, major canals and ditches, and adjacent to culverts on the BNSF Railway where the alignments are parallel. Culverts would be designed to maintain the hydraulic conveyance capacity of the existing stream, canal, ditch, or adjacent culvert. Culverts may feature wing walls, flared outlets, or flared inlets to reduce erosion, and BMPs, such as riprap, would be provided at the discharge end of the culvert to minimize erosion.
- A bridge or the space between piers at an aerial structure would span on the order of 60 to 120 feet. For spans exceeding 120 feet, structure supports are assumed to be located every 120 feet.
- For aerial structures and bridges that span rivers, creeks, floodplains, and floodways, a minimum of 2 feet of freeboard above the 100-year flood elevation would be provided; however, for structures that cross CVFPB-jurisdictional floodways, at least 3 feet of freeboard would be provided above the 100-year flood elevation.
- Piers placed in channels would be designed to minimize backwater effects and local scouring. The shape and alignment of the piers would be designed to minimize adverse hydraulic affects.

Between Fresno and Bakersfield, the existing BNSF Railway and highways cross floodplains and currently impede flood flows at various locations, as shown on FEMA FIRMs. The BNSF Alternative and its alternative alignments may be located either upstream or downstream of existing rail and highways. Where the proposed HST alternative is located downstream, placement of HST tracks on embankment within the floodplain could potentially increase the flood risk to the upstream rail or highway.

Where an upstream hydraulic constriction, such as the existing BNSF Railway, already controls flood flows and elevations, the proposed project would provide cross drainage to meet or exceed the existing upstream hydraulic conveyance capacity. Therefore, the proposed project would not cause an increase in flow velocity or flood elevations at stream crossings adjacent to upstream hydraulic constrictions.

Where the track is constructed on fill but is not located next to an upstream hydraulic constriction, such as an existing road or railroad, openings in the embankment (e.g., bridges, culverts, or wildlife crossing structures) would be sized to allow drainage and flood flows to continue across the proposed alignment. These cross-flow features would be designed to

maintain hydraulic conveyance capacity and to minimize increases to upstream water surface elevations.

The BNSF Alternative would provide wildlife crossing opportunities by means of a variety of engineered structures. These crossings would also serve as hydraulic features where the HST crosses floodplains near creeks, canals, or other drainage features. 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.

Aerial structures and bridges would be designed to span the stream or canal channel, to the extent practicable. Piers or column support structures would be placed within the primary flow channel, the floodplain, and designated floodways as needed to support the aerial or bridge structure. The piers or columns would be spaced approximately 120 feet apart and would have a relatively small cross-sectional area compared to the channel, floodplain, and floodway areas. Columns required in the primary flow channel would be designed to minimize adverse hydraulic effects that could result in substantial backwater effects.

The placement of fill, culverts, bridges, or aerial structures within a CVFPB-designated floodway, or any construction that involves encroachment of a CVFPB or USACE levee must be approved by the CVFPB. The project would prepare an encroachment permit application and submit it to CVFPB for approval prior to construction. To obtain an encroachment permit for federal levees, consultation and design review by USACE would be required.

The project would install aerial structures, bridges, or culverts at natural water body crossings, floodways, and floodplains. Although the pier construction methods have not been determined and would be based on local conditions, it is probable that some crossings would require in-water work for pier construction. Construction in a water body, floodplain, or floodway could impede or redirect flood flows during the construction period because of the presence of construction equipment and materials in the floodplain, depending on the activity occurring within a specific area.

Construction staging areas are proposed in several floodplains, including the Kings River complex, Cross Creek, Tule River, city of Shafter, and Kern River floodplains. Construction staging areas are proposed in CVFPB-designated floodways for Kings River and Cross Creek. Although temporary, construction staging areas may be active for 1 to 3 years.

Additional project features would also be constructed in floodplains. Roadway improvements are planned at major road crossings, including crossings located in floodplains. Bridge overpasses with bridge abutments would be constructed within the Tule River, Deer Creek, County Line Creek, and Poso Creek floodplains. Traction power substations are located within the Deer Creek, Poso Creek, and Kern River floodplains. Freight rail relocation areas are proposed within the city of Wasco and the city of Shafter floodplains. The Shafter East HMF, Shafter West HMF, and Shafter maintenance-of-way facility sites are located within a floodplain.

According to Title 23 of the CCR, work activities, such as excavation, cut-and-fill construction, and obstruction within the floodway and on levees adjacent to a regulated stream, would not be allowed during the flood season unless specifically permitted by CVFPB, pending weather forecasts and river flood conditions. The flood season for the project area, as defined by CVFPB for floodways, is November 1 through July 15. CVFPB allows placement of equipment, material, and structures within a designated floodway as long as the free flow of water is not inhibited and public safety is not jeopardized. Stockpiled material, temporary buildings, and construction equipment that obstruct stream flows would be required to be removed from floodways before

the flood season, unless otherwise permitted by CVFPB. Construction adjacent to a regulated stream would comply with the provisions of Title 23 of the CCR.

The project would incorporate project design features to avoid impacts on floodplains and floodways. The HST would be elevated on aerial structures, or when located on fill, would maintain the existing hydraulic conveyance capacity of the crossing. Structures would be located outside designated floodways, to the extent practicable. The volume of flood flows and locations of floodplains are expected to be the same after project implementation, and project implementation would have minimal change to floodplain values.

Because portions of the alignment are located in FEMA-designated floodplains, the requirements set forth in Executive Order 11988, Floodplain Management, would apply. The floodplain and floodway crossings would be designed and engineered to meet these criteria. This will require documentation of the alternatives analysis and a description of the methods that will be used in the floodplain, such as maintaining existing conveyance that minimizes the risk of flood loss and the impacts of floods on human safety, health, and welfare, and preserves the natural and beneficial values served by floodplains. Additionally, in-kind replacement storage, if needed, would be incorporated into the design to minimize impacts, to the extent practicable, from fill placement that would result in loss of floodplain storage. Some of the encroachments could result in a finding of “only practicable alternative” under Executive Order 11988. If an encroachment is found to be the only practicable alternative, the design must minimize potential harm to or within the floodplain in accordance with Executive Order 11988, and a notice must be prepared to explain why the action is proposed to be located in the floodplain.

No Project Alternative

Under the No Project Alternative, the HST would not be built, and there would be no additional encroachment in the floodplains. Flows at rivers and streams in the project area would not be redirected, and no new impacts related to flooding would occur as a result of the No Project Alternative.

BNSF Alternative

The majority (almost 75%) of the BNSF Alternative would be supported by fill; a small portion would be below-grade (0.1%) and the remaining portion elevated on aerial structures. The HST would cross approximately 24 miles of floodplains, and approximately 60% of this length would be located on fill and have the potential to impede or redirect flood flows.

The floodplain crossings generally stretch over a mile, and the floodplains generally cover a relatively large area. The majority of this area lies within shallow (1 to 3 feet of inundation) flood zones. FEMA BFEs and 100-year flood depths are available at select locations along the BNSF Alternative. Where available, FEMA BFEs and 100-year flood depths are summarized in Table 4.1-1.

In the city of Fresno, the BNSF Alternative would be constructed at-grade or below-grade and include culverts, bridges, or conveyance systems at floodplain crossings, existing canals, and low-lying areas. The alignment would be below-grade in downtown Fresno for approximately 140 yards as it crosses the Fresno Bee railroad spur and would again be below-grade in a shallow trench as it travels underneath East Jensen Avenue. HST tracks set below-grade would have conveyance systems to pass all floodwater from one side of the trench to the other. Retaining walls would prevent floodwater from entering the trench, and siphons perpendicular to the rail alignment would balance floodwaters.

None of the designated floodplains within Fresno contain FEMA- or CVFPB-designated floodways. The shallow floodplain near Church Avenue appears to be a local depression that fills with surface runoff during extreme events as a result of inadequate local drainage systems.

North Central and Central canals cross through the Fresno Works–Fresno HMF site footprint and have 100-year floodplains associated with them. Central Canal is essentially a large irrigation/drainage ditch flowing east to west through Fresno. The base flood flow is mostly contained in the channel with possibly some minor flooding to the immediate sides of the channel. There are no levees along Central Canal. Buildings, parking lots, and other facilities associated with the Fresno Works–Fresno HMF would be located outside the 100-year floodplain.

South of Fresno, the BNSF Alternative would cross the 100-year floodplains and CVFPB-designated floodways associated with Cole Slough, Dutch John Cut, and Kings River (collectively referred to as the Kings River complex). The HST would cross the floodplain on embankment except where it crosses Cole Slough, Dutch John Cut, and the original Kings River channel. At these locations, the alignment would cross the channels on bridges. The soffit of the bridges would be a minimum of 3 feet above the 100-year flood level. Wildlife crossing structures and box culverts would also be installed in the floodplain. The total width of openings in the embankment would be designed to pass the 100-year flood flows without increasing the flood elevation by more than 1 foot in the floodplain. Where CVFPB-designated floodways exist, project design features would minimize the increase of the water surface elevation to less than amounts specified by CVFPB.

The BNSF Alternative would also cross USACE project levees associated with the Kings River complex. The two levees on Cole Slough and the northern levee on Dutch John Cut are federal/state project levees maintained by the Kings River Conservation District (KRCD) under USACE agreement. There are no levees on the original Kings River channel. Construction of the HST over the federal/state levees would comply with 33 USC 408, if applicable, and 33 CFR 208.10, administered by CVFPB. Encroachments to these levees are subject to approval by CVFPB, KRCD, and USACE.

The potential Kings/Tulare Regional Station would not be located within the 100-year floodplain and therefore would have no flooding impacts.

The Kings County–Hanford HMF site is on the western side of the BNSF Alternative southeast of Hanford. This HMF site alternative is not located within a designated 100-year floodplain.

The Cross Creek channel is contained by levees. The levees at Cross Creek are not USACE jurisdictional levees; however, the levee west of the existing BNSF Railway along the southwest edge of the CVFPB-designated floodway has USACE involvement but not formal jurisdiction. The Cross Creek levees are maintained by the Cross Creek Flood Control District. These levees are not certified for urban protection, and therefore are not considered by FEMA as providing urban-level flood protection and are assumed to fail in a flood event.

At Cross Creek, the BNSF Alternative would cross a FEMA-designated 100-year floodplain and CVFPB- and FEMA-designated floodways. The FEMA-designated floodplain of Cross Creek, designated as Zone AE (detailed study with estimated baseline flood elevation), is approximately 14,000 feet wide at the HST crossing. This zone is bounded on both overbanks by about 4,000 feet of designated Zone A (no detailed study). The FEMA-designated floodway is approximately 2,000 feet wide at the BNSF Alternative crossing and the CVFPB-designated floodway is about 14,000 feet at the crossing. The project would submit an encroachment permit application to the CVFPB for crossing the CVFPB-designated floodway.

Most of the Cross Creek floodplain would be crossed on an aerial structure, including the FEMA-designated floodway; however, at-grade construction would occur at the edge of the floodplain

where it is mostly in an "A" zone, or approximate floodplain. In sections where the track would be placed on fill, features to allow flood flows to cross the HST (e.g., culverts, wildlife crossings) would be implemented, as necessary, to maintain existing hydraulic conveyance capacity. Columns would support the aerial structure, and the number of columns would be minimized to the extent practicable; therefore, the columns would displace a relatively small volume of flood water. The crossing would be designed to pass 100-year flood flows without increasing the flood elevation in the FEMA-designated floodway, without increasing water surface elevations by more than 0.1 foot in the CVFPB-designated floodway, and without increasing flood elevations by more than 1 foot in the FEMA-designated floodplain.

The BNSF Alternative would cross Tule River and its associated 100-year floodplain near the Kings/Tulare County border. There are no designated floodways associated with Tule River at the crossing. This reach of Tule River is not leveed. The FEMA-designated floodplain at the Tule River crossing is about 18,000 feet wide and extends primarily north of the Tule River channel. The channel width at the proposed crossing is approximately 250 feet. The BNSF Alternative would cross Tule River by bridge and most of its associated floodplain at-grade. Culverts or wildlife crossing structures would be located at the floodplain where existing culverts are located along the BNSF Railway and would be sized to allow drainage and flood flows to continue across the proposed alignment.

The BNSF Alternative would be downstream of the existing BNSF Railway at Deer Creek. Deer Creek has been channelized at the reach crossed by the BNSF Alternative , and the approximately 40-foot-wide channel has short berms on both sides. This reach is outside of the Deer Creek floodplain. The 100-year floodplain is designated Zone A on the upstream side of the existing BNSF Railway and is approximately 33,000 feet wide. On the downstream side, the floodplain becomes a shallow flooding zone (Zone AO) and narrows to 27,000 feet wide. There is no designated floodway associated with this floodplain. Floodwater appears to back up behind the existing BNSF Railway embankment at the existing BNSF bridge and pass through culverts south of the main channel. The floodplain extends north and adjacent to BNSF Railway tracks, crossing the tracks at low points.

At this floodplain crossing, the proposed HST track would be constructed on fill and on an aerial structure. The Deer Creek channel would be crossed on an aerial structure approximately 1.6 miles in length. The proposed aerial structure would provide clearance and conveyance for flood flows. Where the track is constructed on fill, culverts or wildlife crossing structures would be located where existing culverts are placed along the BNSF Railway and would be sized to allow drainage and flood flows to continue across the proposed alignment. Additionally, dedicated wildlife crossing structures would be provided in the embankment at intervals of approximately 0.3 mile. These cross-flow features would be designed to minimize increases to BFEs and to maintain hydraulic conveyance capacity.

The BNSF Alternative would also cross a floodplain associated with two unnamed small streams at the Tulare/Kern county border (i.e., the County Line Creek) where the alternative would be located adjacent to and downstream of the existing BNSF Railway. Bridges, culverts, or wildlife crossing structures would be located near existing culverts located along the BNSF Railway and would be sized to allow drainage and flood flows to continue across the proposed alignment.

South of the Tulare/Kern County border, the BNSF Alternative would cross the Poso Creek floodplain. Poso Creek is not leveed at this crossing and there is no designated floodway. The floodplain is designated as an "A," or approximate floodplain, and is about 30,000 feet wide at the upstream side of the existing BNSF bridge. The BNSF Alternative would be located downstream and adjacent to the existing BNSF Railway within the Poso Creek floodplain. The BNSF Alternative would cross the Poso Creek floodplain for approximately 9,000 feet. Culverts, as well as wildlife crossings, would be located where existing culverts are installed along the BNSF

Railway and would be sized to allow drainage and flood flows to continue across the proposed alignment. These cross-flow features would be designed to maintain hydraulic conveyance capacity. The BNSF Alternative would result in backwater effects similar to those caused by the existing BNSF Railway, such that difference in water levels due to this alternative would be minimal.

The BNSF Alternative would cross localized areas of flooding within the cities of Wasco and Shafter and south of Shafter. The BNSF Alternative would be mostly elevated through the cities of Wasco and Shafter and at-grade through the floodplain located south of Shafter.

The Kern Council of Governments–Wasco HMF site alternative is located east of the BNSF Alternative and the city of Wasco. This HMF alternative is not within a designated floodplain.

The Kern Council of Governments–Shafter West HMF site alternative is located along the BNSF Alternative south of Shafter.[9] Approximately half of the HMF footprint would be located in a FEMA-designated floodplain. A maintenance-of-way facility, south of Shafter, is partially within this floodplain. The floodplain consists of ponded water in a depression along the highway and existing BNSF Railway and is not associated with conveyance of concentrated flood flows.

Localized FEMA-designated 100-year floodplain areas are situated close to the BNSF Alternative south of the city of Shafter. These designated floodplains consist of local depressions that may pond water during storm events.

In the city of Bakersfield, the BNSF Alternative would cross Kern River, the CVFPB-designated floodway, and the FEMA-designated floodplain on an aerial structure for approximately 2 miles. The project would submit an encroachment permit application to the CVFPB for crossing this CVFPB-designated floodway. The CVFPB-designated floodway at Kern River is approximately 1,500 feet wide at the BNSF Alternative crossing. The crossing and placement of columns would be designed to minimize impacts. The number of columns within the floodway would be minimized to the extent practicable (approximately 13 columns are expected to be required in the Kern River floodway). A local (city of Bakersfield) combination flood control levee and recreation trail are along the south bank of Kern River at the proposed HST crossing. Structural encroachments, modifications, or intrusions to this levee feature would be avoided.

Hanford West Bypass 1 Alternative

The Hanford West Bypass 1 Alternative would cross the CVFPB-designated floodway and FEMA-designated 100-year floodplain associated with Kings River. The CVFPB-designated floodway would be crossed by an aerial structure. The elevated structure would be approximately 0.8 mile in length. Kings River floodplain is a Zone A, or approximate floodplain. About half of the floodplain would be crossed on an aerial structure and at-grade construction would occur at the edges of the floodplain crossing. At the proposed crossing, the Kings River channel width, measured from levee to levee, is approximately 1,625 feet, while the main channel is approximately 400 feet wide. The two levees on Kings River are federal/state project levees maintained by KRCD under USACE agreement. Encroachments to these levees are subject to approval by CVFPB, KRCD, and USACE.

The Hanford West Bypass 1 Alternative would also travel over Cross Creek on an aerial structure. The elevated structure would span approximately 3 miles over the CVFPB- and FEMA-designated floodways at Cross Creek. The remainder of the Cross Creek floodplain would be crossed on fill. This alternative would cross the floodplain and the CVFPB-designated floodway for a slightly

[9] The Kern Council of Governments–Shafter East HMF site is near the Kern Council of Governments–Shafter West HMF site, but is associated with the Wasco-Shafter Bypass Alternative.

longer distance than would the BNSF Alternative, but cross the FEMA-designated floodway for a shorter distance because of the location of the crossing.

Hanford West Bypass 2 Alternative

The Hanford West Bypass 2 Alternative would follow the same route and have the same profile as the Hanford West Bypass 1 Alternative where crossing the CVFPB-designated floodway and FEMA-designated 100-year floodplain associated with Kings River.

Similar to the Hanford West Bypass 1 Alternative, the Hanford West Bypass 2 Alternative would travel over Cross Creek and the FEMA- and CVFPB-designated floodways on an aerial structure. However, the Hanford West Bypass 2 would be located on the eastern side of the BNSF Railway in order to connect to either the Corcoran Elevated Alternative or the Corcoran Bypass Alternative. The Hanford West Bypass 2 Alternative would cross the floodplain and the CVFPB-designated floodway for a slightly shorter distance than would the BNSF Alternative or Hanford West Bypass 1 Alternative. The crossing distance for the FEMA-designated floodway would be similar to that of the BNSF Alternative.

Corcoran Elevated Alternative

The Corcoran Elevated Alternative begins north of West Branch Lakeland Canal within the Cross Creek floodplain and ends south of the Tule River crossing. The Corcoran Elevated Alternative would start elevated, but would return to grade within the Cross Creek floodplain. Wildlife crossing structures and box culverts would be installed in the floodplain. The total width of openings in the embankment would be designed to pass the 100-year flood flows without increasing the flood elevation by more than 1 foot in the floodplain.

The Corcoran Elevated Alternative would elevate a portion of the HST track through the city of Corcoran. The track alignment would be similar to the BNSF Alternative but located east of the existing BNSF Railway. The HST would be elevated through Corcoran on an aerial structure that would extend south of Tule River. The elevated structure would be approximately 6.6 miles long. The effect on floodplains would be similar to that described for the BNSF Alternative.

Corcoran Bypass

The Corcoran Bypass would cross the same floodplains as the BNSF Alternative and Corcoran Elevated Alternative. Within the Cross Creek floodplain, the Corcoran Bypass Alternative would follow the same route and have the same profile as the Corcoran Elevated Alternative.

The HST would be elevated south of Corcoran on an aerial structure approximately 3 miles in length that would extend past Tule River. A portion of the Tule River floodplain would be crossed on fill. Culverts or other features would be installed to allow flood flows to cross the fill and maintain hydraulic conveyance capacity. Dedicated wildlife crossing structures would be placed between 100 and 500 feet to the north and south of the Tule River crossing.

Allensworth Bypass

The Allensworth Bypass Alternative would cross floodplains associated with Deer Creek. There are no designated floodways at the stream crossing. The Deer Creek floodplain is designated Zone A on the upstream side of the existing BNSF Railway; the floodplain narrows and becomes a shallow flooding zone (Zone AO) on the downstream side. The track would be constructed on fill and on an aerial structure approximately 1.6 miles in length. The Allensworth Bypass Alternative would cross approximately 10,000 feet of the Deer Creek floodplain on fill. Where the track is constructed on fill, culverts or wildlife crossing structures would be sized to allow drainage and flood flows to continue across the proposed alignment. These cross-flow features would be

designed to minimize increases to BFEs and to maintain hydraulic conveyance capacity. The aerial structure would provide clearance and conveyance for flood flows. The amount of floodplain area crossed by this alternative would be less than the BNSF Alternative, as shown in Table 5.2-2.

The Allensworth Bypass crosses Poso Creek and its associated floodplain approximately 1,000 to 2,000 feet downstream of the existing BNSF Railway bridge. The total width of openings in the Allensworth Bypass embankment would be designed to pass the 100-year flood flows without increasing the flood elevation by more than 1 foot in the floodplain.

If the BNSF Railway tracks were relocated to be adjacent and parallel to the HST tracks in this area, the backwater effect and resulting water surface elevation would be similar to the Allensworth Bypass Alternative, since the hydraulic conveyance through the new BNSF Railway and HST alignment would be the same as currently exists through the BNSF Railway. The length of the floodplain crossed by the Allensworth Bypass and the relocated BNSF tracks would be about 11,000 feet. Openings in the embankment would be designed to pass the 100-year flood event such that the flood elevation and size of the floodplain would not be affected.

Wasco-Shafter Bypass

The Wasco-Shafter Bypass Alternative would start on the eastern side of the BNSF Railway south of Poso Creek and cross an extension of the Poso Creek floodplain, primarily at-grade.

The Kern Council of Governments–Shafter East HMF site alternative is located along the BNSF Alternative south of Shafter. Approximately half of the HMF footprint would be in a FEMA-designated floodplain. The floodplain consists of ponded water in a depression along the highway and existing BNSF Railway and is not associated with conveyance of concentrated flood flows.

The total amount of floodplain area crossed by this alternative would be less than the BNSF Alternative, as shown in Table 5.2-2. Similar to the corresponding segment of the BNSF Alternative, most of the Wasco-Shafter Bypass would be at-grade. The alternative would bypass the floodplains in Wasco and Shafter and run parallel to the BNSF Alternative, beginning in a localized flooding area south of Shafter, through which the alternative would be partly elevated on an aerial structure.

Bakersfield South

The Bakersfield South Alternative would cross the same floodplain and floodway as the BNSF Alternative at Kern River. The amount of floodplain area and the amount of CVFPB-designated floodway crossed by this alternative would be slightly less than that of the BNSF Alternative, as shown in Table 5.2-2. The HST would be elevated on an aerial structure in Bakersfield in the same manner as the BNSF Alternative. Impacts on the floodplain and floodway would be comparable to those described for the BNSF Alternative.

Bakersfield Hybrid

The Bakersfield Hybrid Alternative would cross the same floodplain and floodway as the BNSF and Bakersfield South alternatives. The amount of floodplain area and the amount of CVFPB-designated floodway crossed by this alternative would be similar to that of the BNSF Alternative, as shown in Table 5.2-2. The HST would be elevated on an aerial structure in Bakersfield in the same manner as the BNSF and Bakersfield South alternatives. Impacts on the floodplain and floodway would be comparable.

5.2.1.2 IMPACT WTR-2: Flooding impacts causing housing to fall within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map

As discussed under Impact WTR-1, construction of HST tracks on embankment or fill within the floodplains has the potential to affect flood levels in the floodplains upstream of the HST. (Elevated sections of the HST would provide clearance and conveyance of flood flows.) Because the floodplains are broad and shallow, major constrictions to flow have the potential to increase BFEs and backwater effects. However, most of the floodplain areas crossed by the HST are in areas with little to no flow (i.e., ponded areas) or sheet flow. Furthermore, openings in the track embankment (e.g., bridges, culverts, wildlife structures) would allow drainage and flood flows to continue across the proposed alignment. These cross-flow features would be designed to maintain hydraulic conveyance capacity and minimize increases in BFEs.

The proposed project passes through Downtown Fresno and Bakersfield and potentially passes through the cities of Wasco and Shafter. The floodplains located in the cities of Fresno, Wasco, and Shafter are local depressions that fill with surface runoff during extreme events as a result of inadequate local drainage systems. No stream channels are associated with these floodplains, so there is no concentrated flow into or out of the area—only surface flow that ponds and then infiltrates or evaporates. The floodplain located in downtown Bakersfield is associated with Kern River, which is confined on the south side of the channel by a flood control levee. The HST would be elevated in the cities of Wasco, Shafter, and Bakersfield; however, portions of the HST would be below-grade in a shallow trench in Downtown Fresno, where retaining walls would prevent floodwater from entering the trench and siphons perpendicular to the rail alignment would balance floodwaters. Because of the lack of concentrated flow in Fresno, Wasco, and Shafter, and because of clearance and conveyance of flood flows in Bakersfield, the potential for backwater from the HST is minimal and is not expected to affect housing in these cities.

Aside from the cities of Corcoran, Wasco, Shafter, and Hanford (which is located several miles from FEMA-designated floodplains), development along the alignment between Fresno and Bakersfield is relatively sparse. Most of the land is agriculture or rural. Although there may be isolated residences close to the HST, larger communities between Fresno and Bakersfield that could be affected by riverine backwater effects from the proposed project are generally several miles upstream (see Table 5.2-1), with the exception of the community of Laton. Most of these communities, such as Kingsburg, Tulare, and Earlimart, are also located well outside the floodplain inundation areas (see Figure 4.1-1). The community of Laton is within the Kings River floodplain (Zone A) upstream of the Hanford West Bypass 1 and Hanford West Bypass 2 alternatives. However, the HST would not be expected to cause backwater effects at Laton because the Kings River channel and CVFPB-designated floodway would be spanned by an aerial structure that would provide flood flow conveyance.

Potential backwater from the HST is not expected to affect housing because of project features, such as aerial structures, bridges, and culverts, which would be designed to maintain existing hydraulic conveyance capacity and to minimize increases to BFEs.

5.2.2 Surface Water Hydrology

5.2.2.1 IMPACT WTR-3: Substantially alter the existing drainage pattern of the site or area, including through the alteration of a stream or river, in a manner that would result in substantial erosion or siltation onsite or offsite

The alteration of drainage patterns that increase surface water volume or rates has the potential to cause channel erosion. Redirecting the flow in a stream or river would alter drainage patterns and increase the potential for erosion along new drainage paths. Increased erosion would lead to

siltation in the flow channel and degradation in water quality at and downstream of altered locations. Introducing impervious surfaces where they currently do not exist has the potential to increase the rate and amount of stormwater runoff and cause erosion in areas adjacent to the new impervious surface and in new or existing drainage channels. The amount of impervious surface area by alternative as compared to the BNSF Alternative is estimated in Table 5.2-3.

Table 5.2-3
Acres Disturbed During Construction of HST Alternatives

Alternative	Acres Temporarily Disturbed	Acres of Permanent Footprint	Acres of Estimated Impervious Surface
Alternatives[a, b, c, d]			
BNSF Alternative	6,020	3,960	708
Hanford Bypass 1, at-grade option	1,000 (1,540)	890 (1,020)	168 (180)
Hanford Bypass 1, below-grade option	950 (1,540)	840 (1,020)	168 (180)
Hanford Bypass 2, at-grade option	1,060 (1,540)	860 (1,020)	168 (180)
Hanford Bypass 2, below-grade option	1,000 (1,540)	810 (1,020)	168 (180)
Corcoran Elevated	630 (750)	270 (410)	61 (61)
Corcoran Bypass	660 (750)	290 (410)	62 (61)
Allensworth Bypass	620 (710)	470 (570)	129 (128)
Wasco-Shafter Bypass	990 (1,430)	630 (790)	126 (131)
Bakersfield South	520 (580)	240 (300)	72 (72)
Bakersfield Hybrid	530 (580)	240 (300)	72 (72)
Station Options[e]			
Fresno Station–Mariposa Alternative	18	21	21
Fresno Station–Kern Alternative	18	19	19
Kings/Tulare Regional Station–East Alternative	22	27	27
Kings/Tulare Regional Station–West Alternative, at-grade option	48	48	48
Kings/Tulare Regional Station–West Alternative, below-grade option	48	48	48
Bakersfield Station–South Alternative	21	19	19
Bakersfield Station–North Alternative	24	20	20
Bakersfield Station–Hybrid Alternative	30	24	24
Heavy Maintenance Facility Alternatives[f]			
Fresno Works–Fresno HMF Site	590	150	65
Kings County–Hanford HMF Site	510	150	65
Kern Council of Governments–Wasco HMF Site	420	150	65
Kern Council of Governments–Shafter East HMF Site	500	150	65
Kern Council of Governments–Shafter West HMF Site	480	150	65

Table 5.2-3
Acres Disturbed During Construction of HST Alternatives

Alternative	Acres Temporarily Disturbed	Acres of Permanent Footprint	Acres of Estimated Impervious Surface

Notes:
[a] Equivalent numbers for the corresponding segment of the BNSF Alternative are presented in parenthesis.
[b] Temporary areas include the permanent footprint, construction staging areas, and precast concrete yards.
[c] Permanent areas include HST tracks, roadway crossings, traction power stations, utility relocation areas and relocation of existing BNSF Railway tracks and related features. Permanent and construction footprints will be refined further during design.
[d] Estimated impervious areas were calculated by multiplying the project alternative length by approximate impervious width, assumed to be 50 feet for the purpose of this calculation.
[e] Existing parking structures are included in the permanent station area but not the disturbed area.
[f] Approximately 150 acres would be disturbed at any of the HMF alternative sites, of which 65 acres would be impervious.
Acronyms:
HMF = heavy maintenance facility
HST = high-speed train

Soil's potential to erode is dependent on a number of factors, including the type of soil, the topography, and the amount and type of precipitation. Steeper slopes and greater amounts of precipitation are two factors that increase the potential for erosion. Because the project area lacks soils that are highly erodible and the topography is generally flat, the Statewide Program EIR/EIS found the Fresno to Bakersfield project would have minimal impacts on erosion (Authority and FRA 2005).

The HST track would have reduced infiltration, which potentially could increase surface water volume or rates locally. The central part of the at-grade track embankment, approximately 40 feet wide, would consist of ballast and tie or slab track bed over a dense sub-ballast and sub-grade. This portion of the embankment would be impermeable, or nearly so. The remainder of the rail alignment (up to 60 feet) would be graded for surface drainage. This peripheral area would be more permeable than the central embankment, and would continue to provide infiltration. Sections of elevated track would be impermeable.

Stormwater would drain towards swales running parallel to at-grade sections of track. In areas where the right-of-way is constrained, swales would be replaced with drainage pipes or lined channels leading to established discharge locations. Tracks set below-grade would have drainage systems to collect stormwater, and this stormwater would be pumped out of the trench and released into a drainage facility. Sections of elevated track would have drainage systems that collect and drain stormwater through downspouts at the columns. Depending upon location, the downspouts would disperse the drainage to the ground below the track in a non-erosive fashion, convey flows to a nearby stormwater collection system, or discharge to a detention basin. In areas with infiltrative soils, runoff would likely infiltrate within the right-of-way. Where the alignment travels through urban areas, impermeable surfaces are common because of past land development; therefore, in most cases existing stormwater systems would convey track runoff. Stormwater runoff from the track would infiltrate locally or be conveyed to stormwater basins or existing stormwater systems. Onsite infiltration or conveyance of stormwater to detention basins or existing storm drain systems would minimize alteration of drainage patterns and potential for erosion.

In areas where the track is on embankment, fill would be used to support sections of the HST track. The introduction of non-native soil with the placement of fill could increase the potential for erosion; however, fill would be compacted, and side slopes would be protected. Culverts would allow drainage across the track embankment. BMPs such as riprap would be provided at the discharge end of culverts for erosion control.

Along the alternative alignments, some of the track in the shallow flood-prone areas would be on aerial structures with support piers. The shallow slope of the valley floor in the project area results in generally low-flow velocities, and therefore, low potential for scour outside of waterways.

The placement of piers within channels and bridge abutments near waterways has the potential to alter drainage patterns and cause localized scour. Kings River (or Kings River complex) and Kern River have the greatest potential for scour because of their larger flows and greater velocities, as compared to the other stream crossings. Piers located within these channels would be designed to allow hydraulically smooth flow and to minimize erosion. Erosion control measures would be implemented at piers and/or bridge abutments to minimize scour and siltation.

Where hardened crossings are installed, the existing shape of the channel and hydraulic conveyance capacity would be maintained. BMPs would be installed downstream of the concrete-lined section to dissipate energy, drainage patterns would not be altered substantially, and scour would be minimized.

The project would comply with federal, state, and local regulations. Where fill is planned at or adjacent to streams or rivers, the project would comply with Section 404 of the CWA and Section 10 of the Rivers and Rivers and Harbors Act, which both require permits for fill activities at specific surface water features, as described in Section 3.1.2. Before construction, the California Department of Fish and Game would be notified of planned alterations of channels, if any, pursuant to Sections 1601 to 1603 of the Streambed Alteration Agreement (California Department of Fish and Game 2009). To comply with federal, state, and local regulations, the project would be required to implement BMPs to reduce the potential for erosion.

The construction of roadway overpasses will slightly increase impervious area because of the lengthening of paved surfaces, compared to the existing at-grade roadway. Stormwater would be collected at the toe of embankments and conveyed to detention basins. Road underpasses would require pump stations that would pump runoff from the low point of the road to either a municipal drainage system or a detention basin. Several rail crossing improvements would require new paved access or frontage roads. In most cases, proposed new roads are in rural areas, and stormwater would run off into roadside ditches and typically infiltrate. In more urban locations, runoff would flow to an existing storm drain system. Onsite infiltration or conveyance of stormwater to detention basins or existing storm drain systems would minimize alteration of drainage patterns and potential for erosion.

Passenger stations would include significant impermeable surfaces such as roofs, platforms, ramps, stairs, buildings, parking areas, and other hard structures. Stormwater design measures to be implemented at the passenger stations may include such features as inlets, grated catch basins, storm drains, flow splitters, detention/infiltration basins, and energy dissipaters, or low-impact design approaches, such as dispersal, infiltration trenches, filter strips, biofiltration swales, and permeable pavement. The Downtown Fresno and Bakersfield stations would be constructed within developed urban areas, would not be adjacent to water bodies, and would have limited, if any, vegetation clearing. The potential Kings/Tulare Regional Station–East and West alternatives would introduce less than 30 acres of impervious surface in a generally flat topographic area. The topography and implementation of stormwater design measures and BMPs, such as drainage ditches and basins, would minimize the alteration of drainage patterns and potential for erosion.

The HMF would cover approximately 150 acres, which would include approximately 65 acres of new impervious surfaces that would result in additional runoff. Site drainage would be designed to capture runoff from impervious areas. An extensive system of pipes and ditches would be required to route the HMF runoff to treatment BMPs (where required) and to one or more stormwater holding areas. If soil conditions are found to be supportive, all or most of the stormwater would be infiltrated onsite. If onsite infiltration cannot be accomplished, stormwater detention would be provided. The storm drainage system at the HMF would minimize alterations to the existing drainage pattern and implement BMPs to minimize the potential for erosion.

5.2.2.2 IMPACT WTR-4: Substantially alter the existing drainage pattern of the site or area, including through the alteration of a stream or river, or substantially increase the rate or amount of surface runoff in a manner that would result in flooding onsite or offsite

The alteration of drainage patterns that increase surface water volume or rates has the potential to cause flooding. For example, alteration of a stream or river has the potential to affect the hydraulics of the watercourse or to redirect flows, and thereby cause flooding.

Cross-drainage through track embankment would be accomplished by installing bridges, culverts, or wildlife crossing structures to convey flood flow from one side of the right-of-way to the other. In general, culverts would be used at ditches and canals that are less than 25 feet wide. Bridges or aerial structures would be used at natural channel crossings or for spanning wider ditches and canals.

As discussed under IMPACT WTR-3, the project would not substantially alter existing stormwater drainage patterns. Within the city of Fresno, urban stormwater runoff is collected in surface drainage structures, pipes, and channels, and is pumped and transported to basins for storage. Stormwater is ultimately either infiltrated or discharged to local irrigation channels. A large portion of the alignment within Fresno is in areas of partially developed urbanized land. Although the project would increase the impermeable footprint, most of the area likely has low permeability because of the urbanized nature of the area. Stormwater runoff along the alignment would be conveyed to the local storm drainage systems or captured and piped to new drainage basins that would be designed for recharge. Because any increased rates and amounts of runoff would be accommodated by the stormwater drainage system or new drainage basins, the new impervious area would not substantially increase the rate or amount of surface runoff that would result in flooding onsite or offsite.

The new Fresno station, parking lot, and portions of the track would be in Downtown Fresno, which has existing impervious surfaces. Therefore, there would be no substantial increase in impervious surface at the station location. Because there would be no increase in impervious surfaces, there would be no increase in the rate or amount of surface runoff that would result in flooding onsite or offsite.

The potential Kings/Tulare Regional Station would be located either east or west of the city of Hanford. The station would introduce impervious surface to an existing pervious area. The runoff from the station would be conveyed to infiltration/detention basins so that there would be no increase in the rate or amount of surface runoff leaving the site.

The majority of urban stormwater runoff in Bakersfield is currently directed to detention basins, with the remainder directed to Kern River or various canals. Stormwater captured on the HST aerial structure would be conveyed to the existing city stormwater drainage system, which would be upgraded as necessary to accommodate any increased flows generated by the new impervious surface of the aerial structure; alternatively, stormwater would be directed to onsite infiltration/detention basins if adequate right-of-way exists. Because any increased rates and

amounts of runoff would be accommodated by the stormwater drainage system or stormwater basin, the potential for flooding in the vicinity of the track and aerial structure as a result of these increased flows would be minor.

The alternative alignments would cross directly above Kern River and its CVFPB-designated floodway on an aerial structure, and columns would be placed in the river channel and floodway. The placement of columns would be designed to minimize impacts. Columns would have a typical diameter of 10 feet, which is small compared to the size of the floodway, and the number of columns within the floodway would be minimized to the extent practicable. Therefore, the columns would displace a relatively small volume of floodwater, and alterations to drainage patterns and the potential flooding would be minor.

At the HMF site alternatives, alterations to drainage patterns would be minimized, and BMPs, such as drainage ditches and infiltration/detention basins, would be implemented to handle runoff. The proposed footprint of the Fresno HMF site is crossed by the Central Canal, which has a FEMA-designated floodplain associated with it, mostly contained within the canal banks. Buildings, parking lots, and other HMFs would be outside the 100-year floodplain. The Kern Council of Governments–Shafter East and Shafter West HMFs would be partially located in a FEMA-designated Zone A floodplain. However, the floodplain is defined by a small depression in the topography and has no water body associated with it. The Kings County–Hanford and the Kern Council of Governments–Wasco HMF sites are not within a designated floodplain.

5.2.2.3 IMPACT WTR-5: Create or contribute runoff water that would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff

Operational activities along the HST alignment and at stations and parking lots could contribute additional polluted runoff to stormwater drainage systems or receiving waters. In Fresno, new station facilities would include parking lots. The parking lot could be an additional source of polluted runoff, potentially generating pathogens, heavy metals, nutrients, pesticides, organic compounds, sediments, trash, debris, and oil and grease. Project-specific BMPs, such as oil/sand separators or infiltration/detention basins, would be developed and implemented to treat runoff from the parking lots before it enters the stormwater drainage system or recharge basins.

South of Fresno to the city of Bakersfield limits, most of the alternative alignments are located in the unincorporated areas of Fresno, Kings, Tulare, and Kern counties (see Figure 4-1). These areas do not have existing stormwater drainage infrastructure. The land use in the area would be similar to existing uses, which include rail operations. The project could potentially increase the amount of pollutants into the Tulare Lake Basin from rail operations. Pollutants of concern generated by the HST could include heavy metals, organic compounds, sediments, trash and debris, and oil and grease. Runoff from the track rights-of-way would be dispersed in a non-erosive fashion, conveyed to a nearby stormwater collection system, or directed through swales to infiltration/detention basins located within the project right-of-way and maintained by the project. These measures would minimize the potential for polluted runoff to reach receiving waters. Because these pollutants would be generated in small quantities, and BMPs would be implemented to minimize the discharge of these pollutants to receiving waters, the potential for introducing new sources of polluted runoff is minor.

There are many road crossings along the proposed HST alignments. New or rerouted roads would be required where the HST would cross existing roads, which would have the potential to increase runoff to existing stormwater drainage systems and introduce new sources of pollutants.

Where the new HST would pass over existing roadways , existing stormwater drainage methods would be maintained. Runoff from the HST track would be conveyed to infiltration basins or to

the existing stormwater drainage system, depending on its capacity and the preference of the local jurisdiction. No new sources of pollutants would be introduced because the existing roadway would remain, and no new activities would be introduced to the existing roadway.

At road closures, the impervious surface would be decreased; therefore, runoff would be reduced. Drainage facilities would be retained where they are necessary to maintain existing flow patterns. The road closures would not introduce any new operational activities or substantial sources of polluted runoff. Rather, the road closures would reduce the amount of polluted runoff.

At rerouted roads, impervious surfaces would increase slightly due to additional pavement. The rerouted road would be near the existing roadway and would not substantially increase impervious surfaces or polluted runoff. Runoff from the new road would be captured in infiltration/detention basins or in an existing stormwater drainage system. Vehicular traffic, and therefore pollutants on the rerouted roads, would be approximately the same as those expected at the closed roadway. Therefore, the rerouted roads would not produce substantial amounts of additional polluted runoff.

Frontage roads would also be built at some roadway crossing locations. Frontage roads would have drainage ditches on each side of the roadway where stormwater would likely infiltrate. The amount of impervious area introduced by these new roads would be small when compared to the size of the SVF watershed, and would therefore not increase runoff or contribute to runoff in a way that would exceed stormwater drainage facilities. Impacts resulting from the frontage roads would be similar to those described for rerouted roads.

Where roadway overpasses would be constructed, embankments would introduce minimal increases in impervious surface. Stormwater would be collected at the toe of the embankment and directed to infiltration/detention basins or conveyed to a nearby stormwater drainage system if it has sufficient capacity.

Subgrade roadway underpasses would require pump stations that would pump stormwater from the low point of the roadway underpass to either a municipal drainage system or infiltration/detention basin. The roadway length would not increase substantially, and roadway use is not anticipated to increase as a result of the project.

In cities along the BNSF Alternative, new drainage basins or upgraded stormwater drainage systems would handle any additional runoff generated by the proposed project. In unincorporated areas, drainage ditches and basins would be installed within the project study area to handle additional runoff.

At the HMF, the new storm drain system would be sized to handle expected runoff at the new facility so that runoff does not exceed its capacity. Maintenance activities have the potential to introduce pollutants to the runoff. Stormwater runoff from maintenance areas and parking lots would be treated before being conveyed to infiltration basins or stormwater drainage systems and would not be discharged directly to water bodies.

Stormwater discharges would also comply with Section 401 of the CWA, which requires a certification for discharges to waters of the United States. Certifications for discharges to receiving waters that are categorized as waters of the United States would be obtained from the Central Valley RWQCB before the implementation of the project.

5.2.3 Surface Water Quality

5.2.3.1 IMPACT WTR-6: Potential for short-term degradation of water quality associated with construction activities that violate water quality standards or waste discharge requirements

Construction activities have the potential to cause erosion or degrade water quality in a manner that violates water quality standards or waste discharge requirements. Construction activities associated with the proposed project would involve clearing and grubbing existing land; handling, storing, hauling, and placing of fill; driving piles; and installing culverts to construct the stations, HMF, elevated structures, and track bed. Placement of fill would disturb the ground surface, decrease vegetative cover, and temporarily increase the potential for erosion and sedimentation. In addition, leakage of fuel, oils, or hydraulic fluid from vehicles and equipment used during construction has the potential to degrade water quality. Increased erosion and sedimentation and any equipment fluid leakage also have the potential to exceed water quality standards and waste discharge requirements. These construction activities have the potential to degrade (by erosion and/or sedimentation) water bodies that receive surface runoff from construction. Such impacts could be exacerbated during the wet season.

Project construction activities involving the disturbance of one or more acres are required to apply for coverage under the SWRCB's NPDES General Permit for Storm Water Discharges Associated with Construction Activities. The project SWPPP would include strategies for preventing impacts on water quality through the use of project-specific structural and/or operation BMPs during construction. The SWPPP would also include BMPs to prevent the discharge of pollutants (e.g., spills) to the environment.

The contractor would be required to implement erosion and sedimentation controls tailored to the project site. The contractor would also be required to comply with erosion, sedimentation, and spill control measures that would be identified in the SWPPP and to implement a monitoring program during construction. The Construction General Permit also requires preparation and implementation of post-construction management measures and a long-term maintenance plan. The project would meet specific post-project performance standards, where project runoff would discharge to a stream or river and post-project runoff site hydrology would match that under pre-project conditions.

Spill control measures would be described in the SWPPP and would outline how contractors handle, store, label, and dispose of hazardous substances (i.e., fuel, waste oil, solvents, and other hydrocarbon-based products) in accordance with federal, state, and local regulations. It would require an emergency response plan and would require that spill-response materials, such as absorbent pads, booms, and other materials to contain spills, to be available at all times to ensure rapid response to spills to protect groundwater and nearby surface water. The contractor would be responsible for reporting any spill discharges.

The proposed project would comply with water quality standards established in the Tulare Lake Basin Plan (Central Valley RWQCB 2004) and guidelines set forth in the project-specific SWPPP for construction activities. The proposed project would also comply with federal, state, and local standards. Additionally, before the commencement of construction activities, the contractor would prepare and implement an SWPPP, including BMPs and good housekeeping practices.

Ground-disturbing activities would occur during the dry season (April through October), to the extent practicable, to minimize the potential for erosion. The contractor would practice good housekeeping during construction. Industry standard BMPs would be implemented to prevent discharge of sediments offsite. These may include, but are not limited to, silt fences and sediment basins. Erosion-control measures and BMPs would reduce runoff velocities and help to

protect nearby water bodies from sediment and construction-related pollutants. Implementation of BMPs, such as designated vehicle maintenance and washing areas and proper storage of equipment and vehicle fluids, would reduce the potential for impacts from leakage of vehicle and equipment fluids on groundwater quality.

Construction-related hazardous materials would be stored, handled, and used, although in relatively small quantities, during construction. The potential release of hazardous materials to the environment could also result in the degradation of water bodies and affect water quality. The *Fresno to Bakersfield Section: Hazardous Wastes and Materials Technical Report* presents an analysis of the potential release of hazardous materials during construction (Authority and FRA 2012).

At bridges and stream crossings of elevated structures, construction activities would occur within channels. BMPs and the spill prevention plan would be implemented to reduce the potential for short-term water quality impacts. BMPs would be used to minimize erosion and sedimentation, and store and use construction-related hazardous materials safely to protect the water quality of the channels.

Water produced during construction dewatering could contain sediments and contaminants that could degrade water quality if the water were to be discharged directly to surface water. However, construction activities are not expected to require dewatering. In the unlikely event that dewatering is required, adherence to the permitting requirements would ensure the water discharged to surface water would not degrade existing surface water quality. The groundwater could be discharged to surface water in accordance with Central Valley RWQCB's Order No. R5-2008-0081, *General Order for Dewatering and Other Low Threat Discharges to Surface Waters* (Central Valley RWQCB 2008), as described in Section 3.3.1, although an individual NPDES permit, or waiver, may be required. In agricultural areas or in other areas where the groundwater would be discharged to land, the discharges could be made under SWRCB's Order No. 2003-0003-DWQ, *Statewide General Waste Discharge Requirements for Discharges to Land with a Low Threat to Water Quality* (SWRCB 2003b), although individual waste discharge requirements or a waiver may be required. In accordance with the requirements of these permits or waivers, the contractor would be required to implement control measures to ensure adequate quality of the discharged water, conduct the appropriate sampling to demonstrate permit compliance, and regulate flow rates to prevent erosion or downstream flooding in the receiving water.

Implementation of control measures in compliance with the permitting requirements, described above, would ensure that construction-related discharges would not degrade water quality or violate any water quality standards or waste discharge requirements. Shallow groundwater is not anticipated along the alternative alignments. Additionally, adherence to the post-construction requirements outlined in the SWPPP would minimize the potential for erosion and siltation at the completion of construction.

5.2.3.2 IMPACT WTR-7: Potential for long-term degradation of water quality associated with operation that violates water quality standards or waste discharge requirements

Without implementation of BMPs, operational activities have the potential to degrade water quality in a manner that violates water quality standards or waste discharge requirements. Because the BNSF Alternative runs parallel to the BNSF Railway for a considerable portion of the Fresno to Bakersfield Section, the HST would not introduce new types of pollutants to the Tulare Lake Basin. However, the presence of the HST could increase the amount of pollutants associated with rail activities that already exist in the watershed by introducing additional track, increasing rail service, and introducing new stations, parking lots, and maintenance facilities. Pollution from the HST tracks could include litter and spills, train lubrication system losses, train

brake system losses, train/rail wear, and surface treatments for embankments and right-of-way (to control vegetation and erosion). Similar types of pollution could be generated at the HMF during train washing, maintenance, and testing. However, the technology proposed for the HST System does not require large amounts of lubricants or hazardous materials for operation. The electric trains would use a regenerative braking technology, resulting in reduced physical braking and associated wear. Runoff from the at-grade tracks and the elevated guideways would have minimal pollutants. Runoff from the HMFs would be treated, as needed, and conveyed to stormwater infiltration/detention basins.

The project would relocate several interchanges and construct new grade-separated roads at a number of project rail crossings in the project area. These new sources of road runoff from the new crossings, relocated highways, or frontage roads could negatively affect water quality. However, the project would be subject to the water-quality design requirements of the RWQCB and of the local agencies to reduce the potential for adverse water-quality impacts.

The SWRCB identifies water bodies that contain high levels of specific pollutants. A TMDL is then developed for constituents to restore the quality of the water body. TMDLs have not been identified for most of the surface-water features in the vicinity of the alternative alignments. Exceptions include the following: Kings River, Cross Creek, and Deer Creek are identified as being impaired with an unknown toxicity at the HST crossing as defined in the SWRCB 2010 Integrated Report, which contains the 303(d) list (SWRCB 2011). The 303(d) list also includes an impairment of chlorpyrifos at the Kings River crossing and high pH at the Deer Creek crossing (SWRCB 2011). Downstream of the HST, impaired water bodies have been identified for Kings River and Fresno Slough. Kings River, approximately 10 miles downstream of the alignments, has been identified as being impaired for electrical conductivity, molybdenum, and toxaphene. Fresno Slough has been identified as being impaired for chlorpyrifos and unknown toxicity. Approximately 55 miles downstream of the alternative alignments, Mendota Pool has been identified as being impaired for mercury and selenium. Operation of the HST would not be expected to introduce substantial quantities, if any, of these pollutants.

With respect to the pollutants listed on the 303(d) list, the project would not contribute toxaphene, a pesticide which is presently banned in the United States and whose use has been severely restricted since the 1980s, nor would it contribute chlorpyrifos, a more recently developed pesticide. The existing molybdenum problem is likely from natural sources or fertilizers. Molybdenum is used as an alloy with steel to increase strength and heat resistance, and sometimes used in lubricants in the form of molybdenum disulfide, so it may exist in the materials used to construct and operate the HST. Molybdenum forms insoluble complexes with copper and sulfate, and therefore, molybdenum would not be in a form or in a quantity that would contribute to water quality degradation.

Electrical conductivity is a surrogate for dissolved solids. Operation of the HST would not contribute any dissolved solids to receiving waters and therefore not contribute to conductivity in Kings River. Because operational activities associated with the HST would conform to federal, state, and local regulations, implementation of the HST would not be expected to introduce substantial quantities, if any, of these pollutants, including any pollutants that would increase pH or any unknown toxicities. In addition to the low amount of pollutants that would be available to be contributed by the HST to receiving waters, the runoff from the HST would be collected in infiltration/detention basins so would contribute only a minor volume of flow to the receiving waters during most storm events.

Beneficial uses have not been identified for many of the existing water bodies adjacent to or within the project study area. Exceptions include Kings River, Cross Creek, Tule River, Poso Creek, and Kern River, as summarized in Table 4.3-1. At each of these crossings, the HST would span the primary flow channel. Because the train would be elevated above the water body,

pollutants are not anticipated to be introduced into the rivers and creeks or adversely affect existing beneficial uses. During storm events, runoff from the track could come into contact with pollutants and transport them into the river or creek. However, no runoff from the project would be discharged directly to any surface water bodies. Runoff from bridges, overpasses, underpasses, and aerial structures would be collected and conveyed to an infiltration/detention basin or to a nearby stormwater collection system, or dispersed in a non-erosive manner. Runoff from the track rights-of-way would be retained onsite, dispersed in a non-erosive fashion, conveyed to a nearby stormwater collection system, or directed through swales to infiltration basins located within the project right-of-way and maintained by the project. Therefore, there would be no discharge directly into a surface water body.

Operations at the HMF would include maintenance and servicing, and would have the potential to introduce pollutants at a localized area. The HMF, including its fueling facilities, would be subject to state and federal hazardous materials regulations. Operational discharges from the HMF would be treated by BMPs, such as infiltration basins or water quality inlets with oil/sand separators, to protect water quality of receiving waters. At the HMF, most train maintenance would occur under roofed areas. Diesel fuel and gasoline would be stored in large underground tanks and would not pose a risk to water quality. However, train and service-vehicle washing could occur outdoors. The HMF would include a system to recycle the wash water from the train sets to reduce water consumption and improve water quality in discharge water. Runoff from this activity would be contained within the site wastewater system, and therefore would not pose a threat to water quality.

For the Fresno Works HMF alternative, several canals would be located within the HMF footprint. One canal is along the border of the Kings County–Hanford HMF site. The HMF would be designed so that there would be no direct discharges of pollutants into the existing canals. No water bodies cross the proposed locations of the Kern Council of Governments–Wasco, Kern Council of Governments–Shafter East, or Kern Council of Governments–Shafter West alternatives. Therefore, the HMF alternatives would have minimal impacts on water quality.

The main sources of pollution from parking areas are litter and spillages, vehicle lubrication system losses, vehicle/tire wear, vehicle exhaust emission, and road surface wear. Potential pollutants generated by the new parking lots include heavy metals, organic compounds, trash and debris, oil and grease, nutrients, pesticides, and sediments. In the Fresno area, urban stormwater runoff is currently collected in FMFCD recharge basins, which is the preferred stormwater management practice. Therefore, stormwater runoff from the proposed project's parking areas in Fresno would be managed in a similar manner by directing the runoff from the parking areas to existing or new recharge basins. If stormwater is conveyed to FMFCD recharge basins, the project would comply with the FMFCD's requirements that protect water quality. In Bakersfield, stormwater runoff from the parking areas would be collected in detention basins, or conveyed to the city's existing storm sewer system in accordance with the city's requirements for stormwater management and water quality protection.

The project would comply with the SWRCB Order No. 97-03-DWQ, General Permit to Discharge Stormwater Associated with Industrial Activity (SWRCB 1997). This permit regulates stormwater discharges from sites that could affect water quality and beneficial uses of receiving waters, as defined in the Tulare Lake Basin Plan. To comply with this permit, the project would be required to prepare an SWPPP that would then be submitted to the Central Valley RWQCB before the start of operations. The SWPPP must describe the project-specific BMPs that the project would implement to protect water quality during operation of the HST. Industry-standard BMPs would be identified and implemented for the general purpose of runoff treatment and pollutant removal, as well as for erosion control. These BMPs may include, but are not limited to, infiltration basins or trenches, oil/sand separators, extended detention basins, biofiltration strips or swales, subsurface infiltration vaults, media filters, and drain inserts. Erosion control BMPs may include

preservation of existing vegetation, soil surface protection, soil binders, or velocity dissipation devices.

Impervious surfaces have the potential to increase the amount and rate of stormwater runoff. Because impervious surfaces do not allow water to infiltrate into the ground, both the quantity and rate of runoff would increase. Increases in impervious surfaces along would be small compared to the size of the drainage basins in which they are located. Additionally, BMPs, such as riprap, would be installed to minimize erosion resulting from increased quantity and rate of runoff.

Additionally, discharges associated with the operation of the HST would comply with the respective county general plans, ordinances, and stormwater requirements to minimize impacts on water quality. The alignment would also comply with municipal requirements, where applicable. In Fresno, discharges from operational activities and stormwater runoff would comply with the City of Fresno General Plan policies, Fresno municipal ordinances, and FMFCD stormwater requirements, if applicable. New drainage basins would be designed to remove pollutants from urban runoff and reduce pollutants in stormwater that reaches receiving waters. In Corcoran and Wasco, the HST would be designed to minimize degradation of water quality in accordance with the city general plan policies and municipal codes. In Bakersfield, the HST would be designed to comply with water quality and waste discharge requirements set forth in the Metropolitan Bakersfield General Plan goals and policies, and the Bakersfield municipal code. The potential for long-term degradation of water quality associated with HST operations would be minimized due to compliance with federal, state, and local water quality regulations.

5.2.4 Groundwater

5.2.4.1 IMPACT WTR-8: Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level

Construction and operation of the project has the potential to deplete groundwater supplies or interfere with groundwater recharge. If the depletion of groundwater supply or the interference with groundwater recharge is substantial, a net deficit in aquifer volume or a lower local groundwater table could occur.

In general, the HST stations are located within existing or planned municipal water distribution areas whereas the HMF sites do not currently have connections to municipal water supply. An exception is the Kings/Tulare Regional Station–East Alternative, which is located just outside of the Hanford urban growth area. If it is not possible or practicable to connect to a municipal supply, a groundwater well (or wells) would be installed and groundwater would be used for water supply. If pumping rates are high enough, they could influence the water level in neighboring wells. Groundwater pumped at a well causes a local drawdown effect. The extent of the drawdown depends on various factors, such as subsurface characteristics (e.g., hydraulic conductivity), pumping rates, volume, and duration.

The HMF would require approximately 50 afy, on average, for domestic use, and the Kings/Tulare Regional Station–East Alternative would require 18 afy of water for domestic use. If this supply comes from local wells and pumping rates are high enough, the water level in neighboring wells could be affected.

The Fresno Works–Fresno HMF would pump groundwater from the Kings Subbasin, the Kings County–Hanford HMF would pump from the Tulare Lake Subbasin, and the three Kern Council of Governments HMF alternatives would pump from the Kern County Subbasin. The Kings/Tulare Regional–East alternative would pump groundwater from the Tulare Lake Subbasin. The

approximately 50 afy of water used at the HMF for domestic water needs, train washing, and landscape irrigation and the approximately 18 afy of water used for municipal supply and landscaping at the station would be considered negligible compared with the amount of groundwater stored in the groundwater basins, as shown in Table 4.5-1, and therefore would not deplete groundwater supplies.

Depending on the rate and volume of pumping, water levels in neighboring wells could be affected by the project. To analyze this potential effect, the radius of influence of a HMF municipal supply well was calculated using the following factors.

- Domestic water use. The HMF would require approximately 50 afy of water, on average, for domestic use. This corresponds to a pumping rate of about 31 gpm, on average (assuming pumping 24 hours per day continuously), or about 62 gpm if pumping occurs 12 hours per day. The station would use approximately 18 afy for municipal supply and landscaping. Potential effects to neighboring wells were evaluated using the more conservative estimate of 50 afy.

- Hydraulic conductivity. The lower San Joaquin Valley has an upper and lower layer separated by a clay aquitard (often referred to as Corcoran Clay). It was assumed that the well would be installed in the lower aquifer. The hydraulic conductivity of this aquifer varies. Faunt (2009) describe results from several well tests in the San Joaquin Valley that provide a range in hydraulic conductivities of coarse-grain material of 31 to 104 feet/day. The calibrated groundwater model described in Faunt (2009) used hydraulic conductivities in the range from 0.24 foot/day for fine-grain material and 3,300 feet/day for coarse-grain material. The aquifer material below the Corcoran Clay layer in the project area tends to be on the order of 20- to 40-percent coarse-grain material (Faunt 2009), resulting in hydraulic conductivities on the order of 600 feet/day. Other studies have shown hydraulic conductivities to be on the order of 60 feet/day. A value of 60 feet/day was used in this analysis.

- Aquifer depth. The depth of the aquifer was assumed to be 1,000 feet. This is consistent with the 1,500-foot depth used in the USGS Central Valley Groundwater Model (Faunt 2009) and the 1,500 to over 3,000 feet reported in the USGS Groundwater Atlas of the United States.

- Storativity. The storativity is a measure of the ability of the aquifer to release water from storage. A value of 8.6 x 10-8/foot was used (Faunt 2009).

Preliminary drawdown calculations based on typical specific yield and storativity values for the aquifers indicate that drawdown resulting from pumping continuously would be expected to be minimal (e.g., less than 6 inches of drawdown at a distance of 100 feet from the pumping well).

Table 5.2-4 shows the wells that were identified within a 1,000-foot radius of the HMF and Kings/Tulare Regional Station locations. The well locations were obtained from the California Department of Water Resources water data library (DWR 2011). No wells were located within 100 feet of the property boundaries. This information has not been field-verified. For the Wasco, Shafter-East, and Shafter-West HMF sites, several wells were located within the HMF footprint. Whether these wells will continue in operation or be abandoned after construction of the HMF has not yet been determined.

The HMF or station may require installing new water supply wells, or abandoning existing wells. In either case, the installation or abandonment of the wells will be done in accordance with local regulations.

A local decrease in the groundwater table could occur where groundwater dewatering is required during construction activities. Dewatering during construction could affect groundwater levels in shallow or first-encountered groundwater-bearing zones in areas with a high-water table.

Construction associated with the proposed project is not anticipated to require dewatering. Groundwater levels in the project area are generally deep (e.g., deeper than approximately 50 feet), as described in Section 4.5. As such, it is not expected that much dewatering would be required during construction of the at-grade sections of the HST. The aerial structure sections of the railroad would be supported by piers. The piers could be either drilled or driven. In the unlikely event that groundwater is encountered, any effects from groundwater dewatering would be temporary, because once construction was completed, dewatering would cease. The natural recharge of the affected groundwater zones would then be re-established.

Increases in impervious surfaces have the potential to result in a net deficit in aquifer volume or a lowering of the groundwater table because of interference with groundwater recharge. Impervious surfaces would be created by the project as a result of the at-grade track bed, aerial structures, roads, parking structures, and the HMF (see Table 5.2-3). However, the amount of impervious surface introduced would be small compared to the groundwater subbasin areas. Additionally, stormwater runoff from the track bed, aerial structures, and roads would be directed into drainage ditches or basins for infiltration or conveyance to an existing stormwater drainage system that includes intentional recharge.

The HMFs would increase impervious surfaces in the study area because they would be located primarily on agricultural land. The new impervious surfaces in the study area created by the HMFs would be surrounded by permeable areas, stormwater runoff would be conveyed to infiltration/detention basins, and new impervious surfaces would be small compared to the groundwater subbasin areas. The HMF sites would have outdoor washing and fuel storage areas, as well as parking lots, which could generate polluted stormwater runoff. However, none of the HMF alternatives are located in areas of shallow groundwater so percolation of stormwater into groundwater would not affect groundwater quality. Because the increase in impervious surface is small compared to the size of the groundwater subbasins, the runoff from impervious surfaces would be directed to a stormwater drainage system that would convey the runoff to a detention or infiltration basin; recharge would not be substantially inhibited by impervious surfaces; and the amount of recharge would be approximately the same compared with existing conditions.

Table 5.2-4
Approximate Distances to Groundwater Wells near the HMF Locations

HST Facility	Well ID	Approximate Distance[a]
Fresno Works–Fresno HMF Site	15S20E12F001M	> 1,000 ft
Kings/Tulare Regional Station–East Alternative (potential)	18S22E28A001M	> 1,000 ft
Kings/Tulare Regional Station–West Alternative (potential)	18S21E34F001M	600 ft
Kings County–Hanford HMF Site	19S22E09C001M	100 ft
	19S22E09B001M	200 ft
	19S22E09M001M	350 ft
	19S22E21C001M	1,000 ft
Kern Council of Governments–Wasco HMF Site	27S25E07L001M	within
	27S25E18F001M	within
	27S25E06N002M	550 ft
	27S25E07M001M	1,000 ft
Kern Council of Governments–Shafter East HMF Site	several	within
	28S25E36A001M	200 ft
	29S26E05C001M	900 ft

Table 5.2-4
Approximate Distances to Groundwater Wells near the HMF Locations

HST Facility	Well ID	Approximate Distance[a]
Kern Council of Governments–Shafter West HMF Site	several	within
	28S26E32P001M	200 ft
	28S26E32C001M	200 ft
	28S26E30J001M	200 ft
	28S26E30F001M	200 ft

[a] Source: DWR 2011. Data have not been field-verified.

Acronyms and Abbreviations:
ft = feet
HMF = heavy maintenance facility

5.2.5 Cumulative Impacts

The cumulative analysis for hydrology and water resources includes the evaluation of floodplains, surface water, and groundwater, as described below.

5.2.5.1 Floodplains

The study area for the cumulative floodplain evaluation consists of FEMA designated 100-year floodplains crossed by the project alternative alignments and the land adjacent to these floodplains. As stated in Section 4.1 (Floodplains), the alternative alignments cross several FEMA-designated floodplains at-grade. Besides existing development in floodplains from past projects, other present and reasonably foreseeable future projects are in the floodplains affected by the proposed project (e.g., the Laton Community Plan Update, the Self-Help Enterprises project, the Delano Marketplace project). All of the project alternatives would be designed to prevent increases greater than 1 foot in the BFE and prevent increases in the flood elevation in floodways in accordance with FEMA. Other ongoing and future federal projects would be required to comply with Executive Order 11988 and NEPA, and state and local projects would be required to comply with CEQA. Also, county general plan policies, programs, and ordinances are intended to offset the potential direct and cumulative flooding problems that may arise from development (e.g., Fresno, Kings, Tulare, and Kern counties have ordinances that limit construction in floodplains). All ongoing and reasonably foreseeable future projects are subject to and would be required to comply with these policies, programs, and ordinances.

5.2.5.2 Surface Water

The SVF watershed defines the boundaries of the cumulative impact analysis for surface water. The development of other present and reasonably foreseeable future projects would result in an increase in impervious surfaces in the watershed. The Fresno to Bakersfield Section would result in an increase in impervious area regardless of which alternative is implemented—a small impact when compared to the total area of the watershed of approximately 34,100 square miles. Runoff from the impervious areas would generally be directed to drainage ditches or basins for infiltration or conveyance to a stormwater drainage system. New development, including HST facilities, would comply with stormwater control ordinances and post-construction hydromodification requirements from NPDES permits, as applicable.

Other present and reasonably foreseeable future projects could have construction schedules that overlap with that of the Fresno to Bakersfield Section. Construction in, across, and/or over

streams and canals has the potential to degrade water quality, and this degradation of water quality could be exacerbated by concurrent construction schedules for multiple projects. However, the identified present and reasonably foreseeable future projects are generally in developed locations (e.g., urban areas, near SR 99), and the cumulative increase in impervious surface associated with these projects would be small compared to the total area of the SVF watershed. Most of the identified present or reasonably foreseeable future projects are greater than 1 acre in area and therefore, pursuant to federal, state, and local regulations (e.g., the CWA), would include BMPs that would control runoff and protect water quality (e.g., use of infiltration basins or vegetated swales to minimize impacts on water quality). Projects affecting areas of less than 1 acre are not expected to increase peak flows substantially and would adhere to local regulations to protect water quality.

Urban and agricultural runoff can carry dissolved or suspended residue of both natural and human land uses within the watershed. Stormwater and irrigation runoff enters streams directly as overland flow, and therefore, surrounding land uses affect surface water quality. Pollutant sources in urban areas primarily include parking lots and streets, industrial uses, rooftops, exposed earth at construction sites, and landscaped areas. Pollutant sources in rural and agricultural areas primarily include agricultural fields and operations. Pollutants in runoff can include sediment, oil and grease, hydrocarbons (e.g., fuels, solvents), heavy metals, organic fertilizers and pesticides, pathogens, nutrients, and debris. Several water bodies have been identified as impaired by pollutant levels under Section 303(d) of the CWA, and TMDLs are established or in progress for these pollutants.

Some of the foreseeable projects identified for the study area (e.g., dairy expansion, new urban development) could create new sources of runoff pollution that would contribute to the cumulative condition; therefore, preservation of water quality is anticipated to be an increasing challenge by 2035 under the cumulative condition. The HST alternatives together with the past, present, and foreseeable projects identified for the study area would potentially create new sources of runoff pollution that would contribute to cumulative impacts. Potential future uses could increase pollution of stormwater runoff by introducing new activities in the area. However, like the HST alternatives, other projects would be subject to regulations and permits required by SWRCB and Central Valley RWQCB to minimize impacts on water quality (e.g., the statewide Industrial General Permit, Order No. 97-03-DWQ [SWRCB 1997]). These regulations are in place to make sure that new developments and infrastructure projects do not result in water-quality-standard violations. Therefore, potential cumulative impacts would be reduced.

5.2.5.3 Groundwater

The five groundwater subbasins crossed by the project alternatives constitute the study area for cumulative impacts on groundwater. These subbasins are described in Section 4.5 (Groundwater).

Planned development and roadway widening projects would increase the impervious surface areas in the groundwater subbasins, as would the proposed HST project. Although the location of infiltration would be slightly altered, runoff from all these projects would generally discharge to the ground surface or unlined drainage ditches or basins. Because surface soils throughout the region are typically pervious, runoff would infiltrate to the groundwater aquifer. New impervious surface areas associated with the HST alternatives and other foreseeable future projects outside the urban areas would be small compared with the size of the subbasins, each of which is over 440,000 acres.

Future water demand for the Tulare Lake Basin has been estimated by DWR (DWR 2009a) under three baseline scenarios that account for changes in water demand from urban development, natural resources restoration, and irrigated crop land, and accounts for state regulatory programs

that improve water quality, protect fish and wildlife, and protect communities from flooding. In all projections of future conditions, urban water use and environmental water use would increase and agricultural water use would decrease. The relatively moderate increases in urban demand would primarily be a result of population growth within the Tulare Lake Basin. Agricultural water demand would be reduced under future conditions from a reduction in irrigated acreage and increases in water conservation (DWR 2009a).

Total water demand is reduced in the Tulare Lake Basin under all three future scenarios (current trends, slow and strategic growth, and expansive growth) if climate change effects are not taken into account. However, total water demand would increase in the future under the expansive growth scenario with almost all of the climate change projections and under the current trends scenario in about one-third of the climate change projections (DWR 2009a).

Groundwater pumped for municipal supply is projected to decrease in the cities of Fresno and Bakersfield but increase in smaller communities without current access to surface supply, such as Hanford and Wasco. The amount of groundwater pumped from underlying aquifers for water supply at the HMF or station would be small (approximately 50 afy and 18 afy, respectively) compared to the estimated storage capacities of the subbasins, each of which is over 12 million acre-feet, and compared to future pumping by local municipal suppliers (City of Fresno 2008, City of Hanford 2011, City of Wasco 2011, California Water Service Company 2011).

Section 6.0
Avoidance and Minimization Measures

6.0 Avoidance and Minimization Measures

The Authority and FRA have considered avoidance and minimization measures consistent with commitments in the Program EIS/EIR documents. During project design and construction, the Authority and FRA would ensure that the measures outlined below are implemented to reduce impacts on water resources. Appendix 2-D of the EIS/EIR provides a matrix that lists relevant standards and regulations for these potential impacts. These measures and standards are discussed in greater detail in supporting documents prepared for the preliminary design, including the following:

- *Technical Memorandum 2.6.5 Hydraulics and Hydrology Guidelines* (Authority 2011)
- *Fresno to Bakersfield Section Hydrology, Hydraulics, and Drainage Report* (Authority 2012b).
- *Fresno to Bakersfield Section Floodplains Impact Report* (Authority 2012a).
- *Fresno to Bakersfield Section Stormwater Quality Management Report* (Authority 2012c).

These measures are considered to be part of the project and are described in the following text. Additionally, the project would also require an Individual Section 404 Permit from the USACE. This permit would have conditions to further minimize water quality impacts.

6.1 Project Design Features for Stormwater Management and Treatment

During the detailed design phase, each receiving stormwater system's capacity will be evaluated to accommodate project runoff for the design storm event. As necessary, onsite stormwater management measures, such as detention or selected upgrades to the receiving system, will be designed to provide adequate capacity and to comply with the design standards in Appendix 2-D of the EIR/EIS and the latest version of *Technical Memorandum 2.6.5 Hydraulics and Hydrology Guidelines* (Authority 2011). Onsite stormwater management facilities will be designed and constructed to capture runoff and provide treatment before discharge of pollutant-generating surfaces, including station parking areas, access roads, new road over- and underpasses, reconstructed interchanges, and new or relocated roads and highways. Low-impact development (LID) techniques will be used to retain runoff onsite and to reduce offsite runoff. Constructed wetland systems, biofiltration and bioretention systems, wet ponds, organic mulch layers, planted soil beds, and vegetated systems (biofilters), such as vegetated swales and grass filter strips, will be used, where appropriate. Stormwater infiltration or detention facilities are to be built in compliance with the design standards indicated in Appendix 2-D of the EIR/EIS. Vegetated set-backs from streams will be used.

6.2 Project Design Features for Flood Protection

The project will be designed to both to remain operational during flood events and to minimize increases in 100-year flood elevations. Design standards will include the following:

- In SFHAs, raise the track above the 100-year flood elevation to prevent saturation and infiltration of stormwater into the sub-ballast.

- Minimize development within the floodplain, to such an extent that water surface elevation in the floodplain would not increase by more than 1 foot, or as required by state or local agencies, during the 100-year flood flow. Avoid placement of facilities in the floodplain (e.g., at the Shafter East and Shafter West HMF sites) or raise the ground with fill above the BFE.

The floodplain crossings will be designed to maintain a 100-year floodwater surface elevation of no greater than 1 foot above current levels, or as required by state or local agencies, and will not increase existing 100-year floodwater surface elevations in FEMA-designated floodways.

The following design standards would minimize the effects of pier placement on floodplains and floodways:

- Design site crossings to be as nearly perpendicular to the channel, as feasible, to minimize bridge length.
- Orient piers to be parallel to the expected high-water flow direction to minimize flow disturbance.
- Elevate bridge crossings at least 3 feet above the high-water surface elevation to provide adequate clearance for floating debris, or as required by local agencies. (The CVFPB requires that the bottom members [soffit] of a proposed bridge must be at least 3 feet above the design floodplain. The required clearance may be reduced to 2 feet on minor streams at sites where significant amounts of stream debris are unlikely.)
- Conduct engineering analyses of channel scour depths at each crossing to evaluate the depth for burying the bridge piers. Implement scour-control measures to reduce erosion potential.
- Use quarry stone, cobblestone, or their equivalent for erosion control along rivers and streams, complemented with native riparian plantings or other natural stabilization alternatives that would restore and maintain a natural riparian corridor.
- Place bedding materials under stone protection at locations where the underlying soils require stabilization as a result of stream flow velocity.

6.3 Construction Stormwater Pollution Prevention Plan

The SWRCB Construction General Permit (Order No. 2009-0009-DWQ, NPDES No. CAS000002) (SWRCB 2009) establishes three erosion project risk levels that are based on site erosion and receiving-water risk factors. Risk Levels 1, 2, and 3 correspond to low-, medium-, and high-risk levels for a project. A preliminary analysis indicates that most of the project would fall under Erosion Risk Level 1, the lowest risk level. However, sections of the project may be more appropriately categorized as Risk Level 2 due to the combination of local rainfall, soil erodibility, and the lengths of the constructed slopes. For example, the portion of the project draining to Kings River would fall under Erosion Risk Level 2. Risk Level 2 measures would also be carried out anywhere in the project vicinity where construction activities are conducted within, or immediately adjacent to, sensitive environmental areas, such as streams, wetlands, and vernal pools.

The Construction General Permit requires preparation and implementation of an SWPPP, which would provide BMPs to minimize potential short-term increases in sediment transport caused by construction, including erosion control requirements, stormwater management, and channel dewatering for affected stream crossings. These BMPs will include measures to provide permeable surfaces where feasible and to retain or detain and treat stormwater onsite. Other BMPs include strategies to manage the overall amount and quality of stormwater runoff. The construction SWPPP will include measures to address, but are not limited to, the following:

- Utilizing hydromodification management to ensure maintenance of pre-project hydrology by emphasizing onsite retention of stormwater runoff using measures, such as flow dispersion, infiltration, and evaporation, supplemented by detention, where required. Additional flow

control measures will be implemented where local regulations or drainage requirements dictate.

- Implementing practices to minimize the contact of construction materials, equipment, and maintenance supplies with stormwater.
- Limiting fueling and other activities using hazardous materials to areas distant from surface water, providing drip pans under equipment, and daily checks for vehicle condition.
- Implementing practices to reduce erosion of exposed soil, including soil stabilization, watering for dust control, perimeter silt fences, placement of rice straw bales, and sediment basins.
- Implementing practices to maintain water quality, including silt fences, stabilized construction entrances, grass buffer strips, ponding areas, organic mulch layers, inlet protection, and Baker tanks and sediment traps to settle sediment.
- Implementing practices to capture and provide proper offsite disposal of concrete washwater, including isolation of runoff from fresh concrete during curing to prevent it from reaching the local drainage system, and possible treatment with dry ice or other acceptable means to reduce the alkaline character of the runoff (high pH) that typically results from new concrete.
- Developing spill prevention and emergency response plan to handle potential fuel or other spills.
- Using diversion ditches to intercept offsite surface runoff.
- Where feasible, avoiding areas that may have substantial erosion risk, including areas with erosive soils and steep slopes.
- Where feasible, limiting construction to dry periods when flows in water bodies are low or absent.

Implementation of a SWPPP is the responsibility of the construction contractor's Qualified SWPPP Practitioner (QSP) or designee. As part of that responsibility, the effectiveness of construction BMPs must be monitored before and after storm events. Records of these inspections and monitoring results are submitted to the SWRCB/RWQCB as part of the annual report required by the Statewide Construction General Permit. The reports are available to the public online. The SWRCB and RWQCB have the opportunity to review these documents.

6.4 Regional Dewatering Permit

The Central Valley RWQCB Order No. R5-2008-0081, *Waste Discharge Requirements General Order for Dewatering and Other Low Threat Discharges to Surface Waters* (Central Valley RWQCB 2008) is a permit that covers construction dewatering discharges and some other listed discharges that do not contain significant quantities of pollutants and that either (1) are 4 months, or less, in duration; or (2) have an average dry-weather discharge that does not exceed 0.25 million gallons per day.

6.5 Flood Protection

The CVFPB regulates specific river, creek, and slough crossings for flood protection. These crossings must meet the provisions of Title 23 of the CCR. Title 23 CCR requires that new crossings maintain hydraulic capacity through such measures as in-line piers, adequate streambank height (freeboard), and measures to protect against streambank and channel

erosion. Section 208.10 requires that improvements, including crossings, be constructed in a manner that does not reduce the channel's capacity or functionality, or that of any federal flood control project. The CVFPB reviews applications for encroachment permits for approval of a new channel crossing or other channel modification. For a proposed crossing or placement of a structure near a federal flood control project, the CVFPB coordinates review of the encroachment permit application with the USACE pursuant to assurance agreements with USACE and the USACE Operation and Maintenance manuals under Title 33 CFR, Section 208.10 and Title 33 U.S.C., Section 408. Under Section 408 of the Rivers and Harbors Act, the USACE must approve any proposed modification that involves a federal flood control project. A Section 408 permit would be required if construction modifies a federal levee. A Section 208.10 permit would be required where the project encroaches on a federal facility but does not modify it.

6.6 Industrial Stormwater Pollution Prevention Plan

The stormwater general permit (Order No. 97-03-DWQ, NPDES No. CAS000001) (SWRCB 1997) requires preparation of an SWPPP and a monitoring plan for industrial facilities that discharge stormwater from the site, including vehicle maintenance facilities associated with transportation operations. The permit includes performance standards for pollution control. The HMF would meet the stormwater treatment requirements of the Industrial General Permit.

Section 7.0
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Section 8.0
Preparer Qualifications

8.0 Preparer Qualifications

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