12.0 Hydrology - Flood Management

This chapter describes the environmental and regulatory settings for flood management and environmental consequences and mitigation, which could potentially be affected by implementation of Project alternatives.

12.1 Environmental Setting

The environmental setting for flood management includes a discussion of flood protection history in the San Joaquin River basin, flood management structures, and flood management operations and conditions. Much of the information presented in this section was obtained from the Upper San Joaquin River Basin Storage Investigation Initial Alternatives Report Information Report, Flood Damage Reduction Technical Appendix (U.S. Department of the Interior, Bureau of Reclamation [Reclamation] and California Department of Water Resources [DWR] 2005) and is summarized below.

12.1.1 Historical Perspective of Flood Protection in the San Joaquin River Basin

Historically, the San Joaquin River had insufficient capacity to carry heavy winter and spring flows generated by precipitation and/or snowmelt within its channel banks. Once flows exceeded channel capacities, the channels overflowed onto the surrounding countryside, forming vast floodplains. Velocities in overbank areas were greatly reduced from velocities in the channels reducing the sediment-carrying capacity of the water allowing material naturally eroded from mountain and foothill areas to drop out of suspension. In this way, over many years, the San Joaquin River built up its bed and formed natural levees composed of heavier, coarser material carried by flood flows. Finer material stayed in suspension much longer and dropped out when overflow water ponded in basins that developed east and west of the river. The higher elevation land formed by the natural levees attracted the first settlements in the Central Valley. In the early 1800s, settlers and Native Americans described the Sacramento and San Joaquin rivers as “miles wide” during flooding.

Early Flood Protection

Initial flood protection in the Central Valley developed in a piecemeal fashion with the construction of levees to protect local areas from flooding. Levees were typically constructed in response to a past flood, with little or no coordination between different localities. As the private levee system developed, the protection afforded by individual levees decreased because of the increased heights of floodwaters constrained between the levees. The increased flood danger led to competition between landowners to continually raise and strengthen levees by stages to protect local areas and direct floodwaters elsewhere.

By the early 1900s, it was evident that local efforts would not be adequate to provide flood protection to agricultural lands in the Sacramento River and San Joaquin River basins. In 1920, Colonel Robert Marshall, chief geographer for the U.S. Geological Survey (USGS), proposed a major water storage and conveyance plan to transfer water from Northern California to meet urban and agricultural needs of central and Southern California. This plan ultimately provided the framework for development of the Central Valley Project (CVP). Under the Marshall Plan, a dam would be constructed on the San Joaquin River near Friant to divert water north and south to areas in the eastern portion of the San Joaquin Valley, and provide flood protection to downstream areas. The diverted water would be a supplemental supply to relieve some of the dependency on groundwater that had led to overdraft in areas of the eastern San Joaquin Valley. Water in the Sacramento Valley would be collected, stored, and transferred to the San Joaquin Valley by a series of reservoirs, pumps, and canals.

In 1933, the California State Legislature approved the Central Valley Project Act, which authorized construction of initial features of the CVP, including Shasta Dam; Friant Dam; power transmission facilities from Shasta to Tracy; and the Contra Costa, Delta-Mendota, Madera, and Friant-Kern canals. However, the Great Depression prevented the State from financing the project so the State appealed to the Federal Government for assistance in constructing the CVP.

Congress appropriated funds and authorized construction of the CVP and construction began on October 19, 1937, with the Contra Costa Canal. Construction of Shasta Dam began in 1938 and was completed for full operation in 1949. Friant Dam, on the San Joaquin River, was also completed in 1949.

The Flood Control Act of 1944 authorized the Lower San Joaquin River and Tributaries Project. The project included constructing levees on the San Joaquin River below the Merced River, Stanislaus River, Old River, Paradise Cut, and Camp Slough. Construction was initiated on the Lower San Joaquin River and Tributaries Project in 1956. The Chowchilla and Eastside bypasses were constructed by the State as part of the Lower San Joaquin River Project.

12.1.2 Flood Management Structures

Friant Dam

Friant Dam is the principal flood damage reduction facility on the San Joaquin River and is operated to maintain combined releases to the San Joaquin River at or below a flow objective of 8,000 cubic feet per second (cfs). Several flood events, as described below, in the past few decades have resulted in flows greater than 8,000 cfs downstream from Friant Dam and, in some cases, flood damages resulted.

The existing Friant Dam is a 319-foot-tall concrete gravity dam with a crest length of 3,488 feet and a crest width of 20 feet. Millerton Lake, formed by Friant Dam, has a volume of 524 thousand acre-feet (TAF). The dam serves the dual purposes of storage for irrigation and flood management. The minimum operating storage of Millerton Lake is 130 TAF, resulting in active available conservation storage of about 390 TAF. The minimum operating storage allows for diversion from dam outlets to the Friant-Kern Canal, Madera Canal and the San Joaquin River. During the rainy season of October through March up to 170 TAF of available storage space must be maintained for management of rain floods.

San Joaquin River

Except for a small area to the west and south of Fresno Slough, the Project area is located in a Federal Emergency Management Agency (FEMA) Special Flood Hazard Zone A (no base flood elevations have been determined). The area adjacent to Fresno Slough is designated as Zone AO (1-3 feet of flood depth).

Chowchilla Bypass and Chowchilla Bifurcation Structure

The flood control structure most relevant to Reach 2B is the Chowchilla Bypass and Chowchilla Bifurcation Structure, owned by DWR and the Central Valley Flood Protection Board (CVFPB) for the State of California. The Chowchilla Bypass begins at the Chowchilla Bifurcation Structure in the San Joaquin River and runs northwest, parallel to the San Joaquin River, to the confluence of the Fresno River, where the Chowchilla Bypass ends and essentially becomes the Eastside Bypass. The design channel capacity of the Chowchilla Bypass is 5,500 cfs. The bypass is constructed in highly permeable soils, and much of the initial flood flows infiltrate and recharge groundwater. The Chowchilla Bifurcation Structure is a gated structure that controls the proportion of flood flows between the Chowchilla Bypass and the San Joaquin River Reach 2B. The bifurcation structure has a drop (plunge pool) on the downstream side in both the San Joaquin River and Chowchilla Bypass, and has no fish passage facilities. The Chowchilla Bifurcation Structure is operated to keep flows in Reach 2B at a level less than 2,500 cfs because of channel design capacity limitations. Therefore, operating rules for the Chowchilla Bifurcation Structure are based on initial flow to the San Joaquin River and initial flow to the Chowchilla Bypass (McBain and Trush 2002). The intended design capacities for the various sections of the San Joaquin River reaches in the Project area are described in Table 12-1.

Mendota Dam

Mendota Dam is located at the confluence of the San Joaquin River and Fresno Slough. Mendota Pool is a small reservoir, with approximately 8,000 acre-feet of storage, created by Mendota Dam. The Mendota Pool does not provide any appreciable flood storage. The water surface elevation in the pool is maintained by a set of gates and flashboards that are manually opened/removed in advance of high-flow conditions. This process lowers the water level in the pool for passing high flows to reduce seepage impacts to adjacent lands, but hinders distribution of flows into the canals.

Over time, the Mendota Pool has partially filled with sediment during infrequent high-flow releases from Friant Dam. During times of high flows, some unknown portion of this sediment is able to flush and route downstream when flashboards have been removed, restoring much of the Mendota Pool storage capacity. If the flashboards are not removed before a high-flow event from either the San Joaquin River or Kings River via Fresno Slough, the increased water surface elevations cause seepage problems on upstream and adjacent properties. Additionally, there have been recurring problems with water seeping under Mendota Dam, threatening the structural integrity of the dam. The Mendota Pool is drained every other year to inspect Mendota Dam footings.

Table 12-1.
Design Capacities of San Joaquin River and Chowchilla Bypass Within the Project Area and Vicinity

Reach	Upstream Extent	Downstream Extent	Levee Type[a]	Design Capacity (cfs)[b]
Reach 2A	Gravelly Ford	Chowchilla Bifurcation Structure	Project	8,000
Reach 2B	Chowchilla Bifurcation Structure	Mendota Dam	Non-project	2,500
Reach 3	Mendota Dam	Sack Dam	Non-project	4,500
Reach 4A	Sack Dam	Sand Slough Control Structure	Non-project	4,500
Kings River North	Fresno Slough Bypass	Mendota Pool	Non-project	4,750
Chowchilla Bypass	Chowchilla Bifurcation Structure	Confluence with Fresno River and Eastside Bypass	Project	5,500
Eastside Bypass	Fresno River	Sand Slough Bypass	Project	10,000-17,000
Sand Slough Bypass	Sand Slough Control Structure	Eastside Bypass	Project	3,000

Notes:
[a] Project levees are those levees constructed to Federal standards as part of a Federal flood control project, in this case, the Lower San Joaquin River Flood Control Project, and non-project levees are those constructed by individual landowners to protect site-specific properties.
[b] Design capacity is defined by the Corps as the amount of water that can pass through reaches of the San Joaquin River and Chowchilla Bypass with a levee freeboard of 3 feet.
Key:
cfs = cubic feet per second

Fresno Slough and the Kings River

Fresno Slough connects the Kings River to the San Joaquin River through the James Bypass. The James Bypass is a leveed channel beginning in the lower Kings River basin and runs northwest to Fresno Slough. The Fresno Slough delivers water to the south from Mendota Pool during irrigation season, and delivers water to the Mendota Pool and San Joaquin River from the Kings River when the Kings River is flooding. Due to this flood inflow, Kings River system operations influence operations on the San Joaquin River at Chowchilla Bifurcation Structure, Mendota Pool, and downstream.

Levees

There are two classes of levees and dikes along the San Joaquin River near Reach 2B: (1) those associated with the Lower San Joaquin River Flood Control Project (project levees), and (2) those constructed by individual landowners to protect site-specific properties, and thus not associated with the Lower San Joaquin River Flood Control Project (non-project levees). There are only non-project levees in Reach 2B; however, project levees exist along the lower portion of Reach 2A and along the entire length of the Chowchilla Bypass.

The San Joaquin River Flood Control Project consists of a parallel conveyance system: (1) a leveed bypass system on the east side of the San Joaquin Valley, and (2) a leveed flow conveyance system in the San Joaquin River. The main stem of the San Joaquin River levee system is composed of approximately 192 miles of project levees and various non-project levees located upstream from the Merced River confluence. Project levees are levees constructed as part of the San Joaquin River Flood Control Project by the Corps, and occur in Reach 2A downstream from Gravelly Ford and extend downstream to the Chowchilla Bifurcation Structure. There are no project levees in Reach 2B. Information on dimensions of estimated channel capacities for locally constructed levees is difficult to obtain and, in some cases, is currently unavailable.

Figure 12-1 shows the levee flood protection zones for the San Joaquin River. Under California Water Code section 9110, subdivision (b), "Levee Flood Protection Zone" means the area, as determined by the CVFPB or DWR that is protected by a project levee. DWR delineated the levee flood protection zones by estimating the maximum area that may be flooded and where flood levels could exceed 3 feet deep if a project levee fails with flows at maximum capacity that may reasonably be conveyed. Reach 2B is not protected by project levees. However, the levee flood protection zone map shown in Figure 12-1 indicates that the entire Project area is subject to inundation with some areas subject to flooding greater than 3 feet if a levee was to fail.

12.1.3 Flood Management Operations and Conditions

The following sections contain information about flood management operations in the Project area and vicinity.

San Joaquin River

The 8,000 cfs objective flow from Friant Dam is generally considered to be a safe carrying capacity, though some flood damages to adjacent land developments can occur when objective flows are passed. These damages can occur because of levee under-seepage and through-seepage, and backwater effects on local storm drainage systems. Design capacity is defined by the Corps as the amount of water that can pass through reaches of the San Joaquin River with a levee freeboard of 3 feet. Design capacity was intended to provide protection against a 50-year storm (McBain and Trush 2002). The intended design capacity of Reach 2B is 2,500 cfs with 3-foot freeboard.

In all cases, water from the Kings River system has priority to use available capacity in the San Joaquin River below the Mendota Pool. When flood flows are below channel capacities, the Lower San Joaquin Levee District (LSJLD) has the latitude to best use the design capacities of the Lower San Joaquin River Flood Control Project.

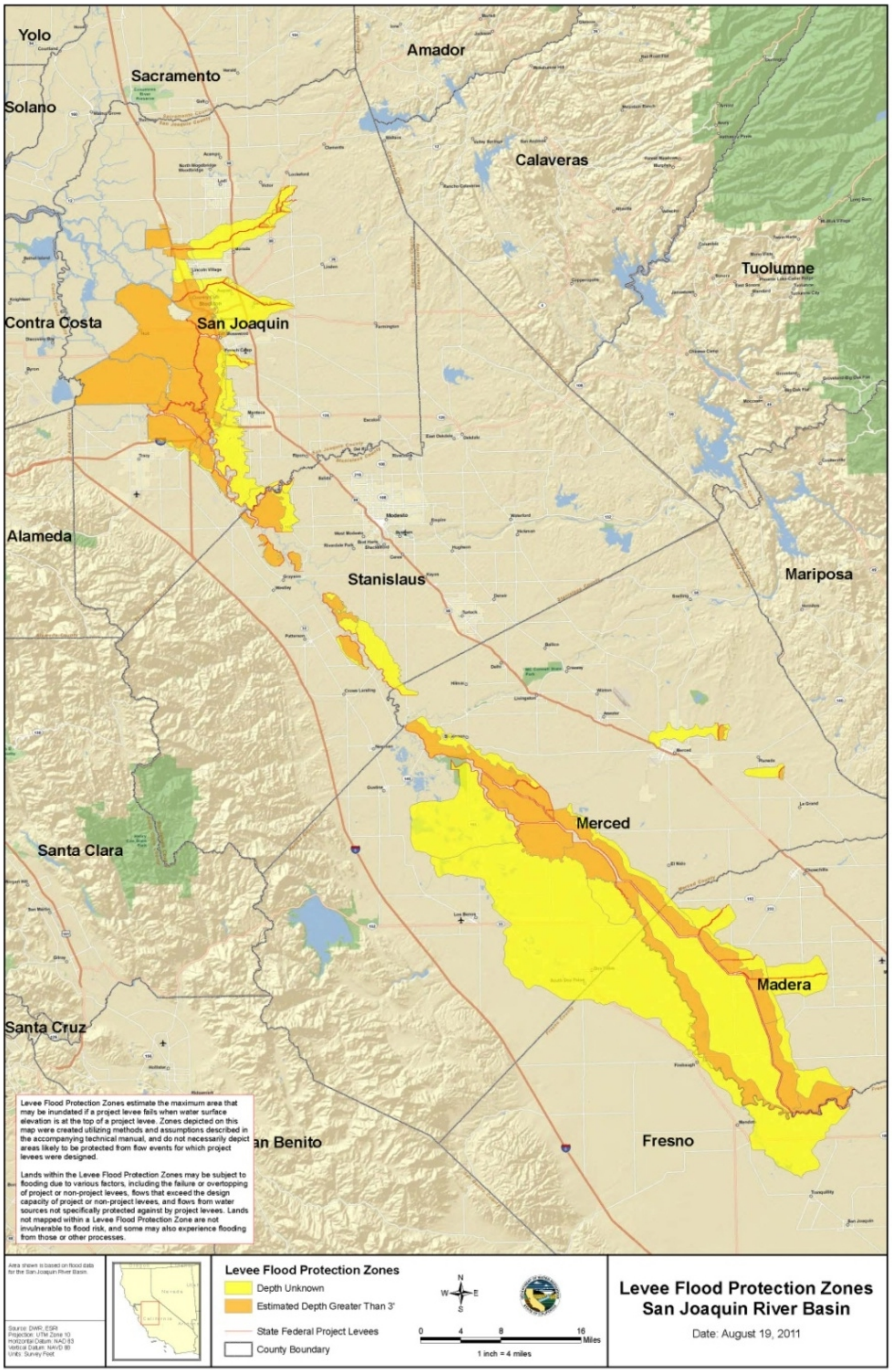


Figure 12-1.
Levee Flood Protection Zones in the San Joaquin River Basin

The following operation and maintenance guidelines describe how the system is operated (Reclamation Board 1969).

- The first increment of flow down the San Joaquin River may be routed through either the San Joaquin River or the Chowchilla Bypass. Up to 2,500 cfs would normally be routed through the San Joaquin River insofar as it does not exceed the capacity of the river when added to the releases from the Kings River. Up to 5,500 cfs would be passed through the Chowchilla Bypass Bifucation Structure. A total flow of 8,000 cfs would normally be divided with 2,500 cfs passing to the river and 5,500 cfs passing to the Chowchilla Bypass.
- Should the flows exceed 8,000 cfs at the control structures or 10,000 cfs at the latitude of Mendota (i.e., the total flow in the San Joaquin River, via Reach 2 and James Bypass/Fresno Slough, and the Chowchilla Bypass at the latitude of Mendota), the LSJLD would operate the control structures at their own discretion with the objective of minimizing damage to the flood control project and protected area.

Major Recent Floods

The following flood event descriptions as reported in Reclamation and DWR (2005) are drawn from the Corps report (Corps 1999). Between 1900 and 1997, the Sacramento River and San Joaquin River basins experienced 13 destructive floods each located in a different portion of the Central Valley. The most recent floods (1983, 1986, 1995, and 1997) caused extensive damage in both the Sacramento River and San Joaquin River basins and raised questions about the adequacy of the current flood management systems and land use in the floodplains. In response to these floods, Congress authorized the Corps in 1997 to undertake a comprehensive study of the flood damage reduction facilities in the Sacramento River and San Joaquin River basins, and to prepare a summary of recent flood events.

Flood of 1955. The flood of 1955 occurred in December, was centered north of Friant Dam, and was more intense in the northern portions of the San Joaquin Valley and in the Sacramento Valley. Before the start of the flood, Millerton Lake was well below flood management space and, as a result, flows on the San Joaquin River were completely controlled by Friant Dam. The peak flow release from Friant Dam for this storm occurred on January 5, 1956, at 7,120 cfs. The flow stayed high for about 6 weeks.

Flood of 1967. Above-normal precipitation that occurred continuously from December 1966 through March 1967 resulted in the flooding of 35,000 acres of the San Joaquin River basin. A record-breaking storm in early December 1966 resulted in very high runoff from the San Joaquin River. The San Joaquin River above Millerton Lake experienced high runoff during early December with a maximum mean daily inflow of 18,450 cfs to the lake. The release from Millerton during this event was about 5,000 cfs and lasted about 1 week. A vast snowmelt from April to July resulted in significant flood damage from flooding in the lower portions of the Fresno and Chowchilla rivers. Nearly all of the flooded areas were cropland, improved pasture, or grazing land. Releases from Millerton climbed to about 8,000 cfs in the first week of April and remained there until the beginning of June. Flow did not return to normal until mid-July.

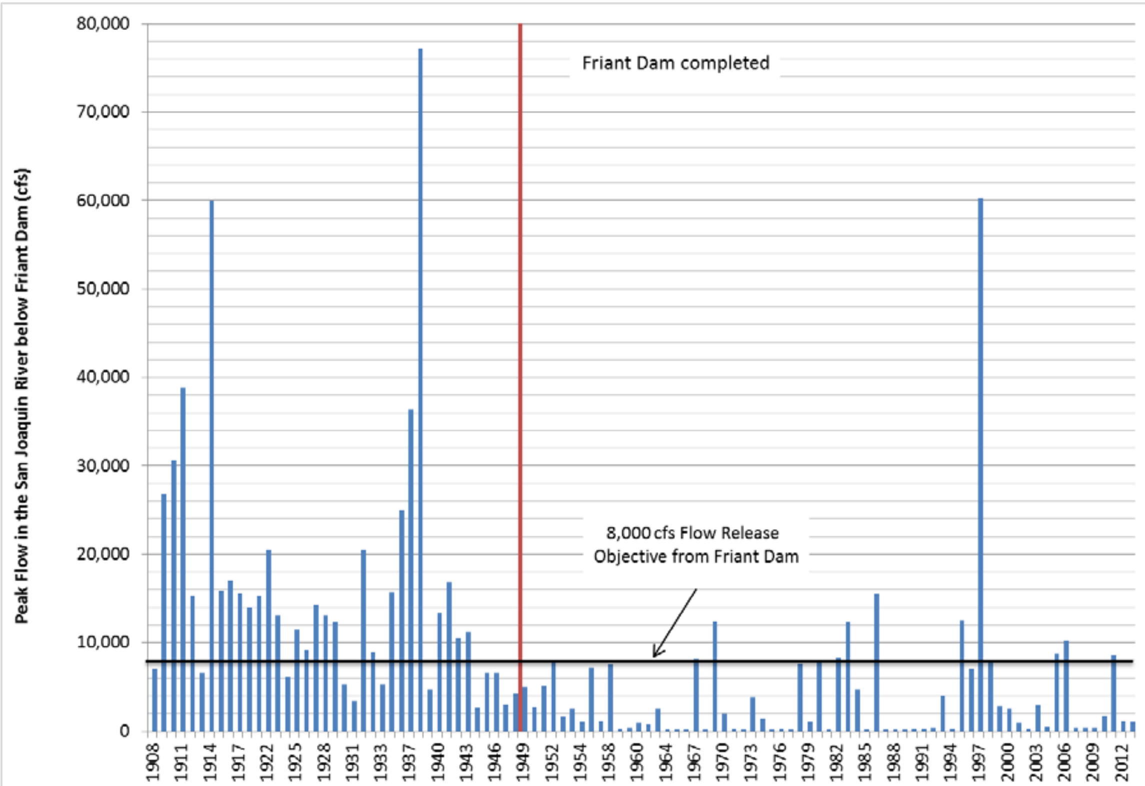
Flood of 1983. Water year 1983 was one of the wettest on record in California, a result of El Niño weather conditions. Northern and Central California experienced moderate flooding incidents from November through March because of numerous storms. In early May, snow water content in the Sierra Nevada exceeded 230 percent of normal, and the ensuing runoff resulted in approximately four times the average volume for Central Valley streams. In the San Joaquin River basin, levee breaks caused flooding at four locations along the San Joaquin River. Estimated damages exceeded $324 million in the San Joaquin River basin (Corps 1999). Releases from Millerton started to increase in the beginning of November reaching over 12,000 cfs in July, after which they returned to more normal conditions.

Flood of 1986. Flooding in 1986 resulted from a series of four storms over a 9-day period during February. Rains from the first three storms saturated the ground and produced moderate to heavy runoff before the arrival of the fourth storm. Peak daily inflow to Millerton Lake was about 20,800 cfs. Estimated damages exceeded $15 million in the San Joaquin River basin (Corps 1999). The peak flow from Millerton was 15,500 cfs on February 18. Flows started to return to normal in about mid-April.

Flood of 1995. El Niño conditions in the Pacific forced major storm systems directly into California during much of the winter and early spring of 1995. The largest storm systems hit California in early January and early March. The major brunt of the January storms hit the Sacramento River basin and resulted in small stream flooding primarily because of storm drainage system failures. The March 1995 storms were concentrated on the coastal range, and caused high flows in some of the west side tributaries to the San Joaquin River basin. Peak daily inflow to Millerton Lake was about 23,700 cfs. In total, estimated flood damages in 1995 exceeded $193 million in the San Joaquin River basin (Corps 1999). The peak release from Millerton was 12,500 cfs on March 11, but releases were high from the first week in March to almost August.

Flood of 1997. December 1996 was one of the wettest Decembers on record in the Central Valley. Watersheds in the Sierra Nevada already were saturated by the time three subtropical storms added more than 30 inches of rain in late December 1996 and early January 1997. The third and most severe of these storms lasted from December 31, 1996, through January 2, 1997. Rain in the Sierra Nevada caused record flows that overwhelmed the flood management system in the San Joaquin River basin. Peak daily inflow to Millerton Lake was about 51,800 cfs, with a peak hourly inflow of about 95,000 cfs. Peak daily outflows to the San Joaquin River from Friant Dam were estimated at 37,500 cfs, with a peak hourly outflow of 62,900 cfs. Dozens of levees failed throughout the river system and widespread flooding ensued. Estimated damages exceeded $223 million in the San Joaquin River basin (Corps 1999).

Since 1997 there have been four large flow releases from Friant Dam. In the beginning of June 1998, the flow increased to about 8,000 cfs and remained there for about 3 weeks then slowly decreased to normal levels. In mid-May 2005, the releases from Friant Dam increased to almost 9,000 cfs and remained there for about 2 weeks before dropping to more normal levels. In the beginning of April 2006, the releases increased to 10,000 cfs and remained high for several months decreasing to normal levels in July. In the beginning of April 2011, the releases increased over 8,000 cfs and remained high for several weeks. Releases peaked again in the end of June and the beginning of July 2011, reaching up to 8,500 cfs. Figure 12-2 shows the peak annual flows below Friant Dam (or at that location before Friant Dam was constructed). Since the dam was constructed in 1949 there have been only 12 events with releases from Friant Dam that exceeded the maximum flow objective of 8,000 cfs. Some of these events lasted many days or months.



Dates before construction of the Dam were collected in the river at the same location.

Figure 12-2.
Peak Annual Flows in the San Joaquin River below Friant Dam

12.1.4 Flood Management Agencies

Federal Emergency Management Agency

Congress established the National Flood Insurance Program to address both the need for flood insurance and the need to lessen the devastating consequences of flooding. FEMA works closely with State and local officials to identify flood hazard areas and flood risks. Floodplain management requirements within high-risk areas, known as Special Flood Hazard Areas, are designed to prevent new development from increasing the flood threat, and to protect new and existing buildings from anticipated flood events. Because the levees in Reach 2B are not authorized flood control levees, the Project area is within a FEMA-designated 100-year flood hazard zone.

U.S. Army Corps of Engineers

The Corps has nationwide responsibility for flood management. In California, flood management on the San Joaquin River system and other rivers is a combination of the Corps, Reclamation, State, and private projects; all operated under the Corps official flood management plans. The Corps has emergency authority to fight any flood to protect life and property and to rehabilitate Federal flood management facilities that are maintained by State and local entities.

Central Valley Flood Protection Board

The CVFPB was established to accomplish the following:

- Control flooding along the Sacramento and San Joaquin rivers and their tributaries, in cooperation with the Corps. This includes working with all permit requests for construction of improvements of any nature within the limits of a Federal project right-of-way; permit requests are referred to the Corps District Engineer for review (in accordance with the provisions of 33 Code of Federal Regulations (CFR) Section 208.10).
- Cooperate with various agencies of the Federal, State, and local governments in establishing, planning, constructing, operating, and maintaining flood control works.
- Maintain the integrity of the existing flood control system and designated floodways through the CVFPB's regulatory authority by issuing permits for encroachments.

California Department of Water Resources

DWR established the Division of Flood Management in November 1977, although flood forecasting and flood operations had been integral functions of the DWR and its preceding agencies for about a century. Today, the functions of statewide flood forecasting, flood operations, and other key flood emergency response activities are the primary missions of the Division of Flood Management Hydrology and Flood Operations Office. Other components of the Division of Flood Management include Flood Projects Office, Flood Maintenance Office, FloodSAFE Program Management Office, and the Central Valley Flood Planning Office.

The Division of Flood Management, among several others, is carrying out the work of DWR’s California FloodSAFE Initiative program, which partners with local, regional, State, Tribal, and Federal officials in creating sustainable, integrated flood management and emergency response systems throughout California. DWR is responsible for inspecting Federal project levees and has an obligation to prepare a State Plan of Flood Control and Central Valley Flood Protection Plan. Both plans are required to incorporate any modifications to the flood management system anticipated under the Settlement. In June 2012 the CVFPB adopted the 2012 Central Valley Flood Protection Plan. The plan lays out the goals and objectives to flood protection including ecosystem integration over the following 5 years and includes a vision for long-term flood management over the next 20 to 25 years (DWR 2012).

Lower San Joaquin Levee District

The LSJLD was created in 1955 by a special act of the State Legislature to operate, maintain, and repair levees, bypasses, and other facilities built in connection with the Lower San Joaquin River Flood Control Project. The district encompasses approximately 468 square miles (300,000 acres) in Fresno, Madera, and Merced counties. LSJLD is responsible for operation and maintenance and emergency management of State flood control facilities within the district boundaries including 191 miles of levees, channel bottoms, and flood management facilities. The LSJLD is not responsible for operation and maintenance of privately owned levees. Operations and maintenance activities include vegetation management activities, sediment management and removal activities, cleaning of screens and trash racks on facilities, opening and closing gates and flap gates in the bypass systems, and flood watch. Important facilities maintained by the district include the Chowchilla Bypass, the Eastside Bypass, and the Mariposa Bypass.

12.2 Regulatory Setting

The Federal, State, and regional and local regulatory setting of the Project as it pertains to flood management is described below.

12.2.1 Federal

The Federal regulatory setting describes Executive Order (EO) 11988, and Section 14 of the Rivers and Harbors Act (RHA).

Executive Order 11988 (Flood Hazard Policy)

EO 11988 is a flood hazard policy for all Federal agencies that manage Federal lands, sponsor Federal projects, or provide Federal funds to State or local projects. It requires that all Federal agencies take necessary action to reduce the risk of flood loss; restore and preserve the natural and beneficial values served by floodplains; and minimize the impacts of floods on human safety, health, and welfare. Specifically, EO 11988 dictates that all Federal agencies avoid construction or management practices that would adversely affect floodplains unless that agency finds no practical alternative, and the proposed action has been designed or modified to minimize harm to or within the floodplain.

Rivers and Harbors Act (Section 408)

Section 14 of the RHA (commonly known as Section 408) was approved by the Federal Government on March 3, 1899 (33 United States Code 408). The act provides that the Secretary of the Army, on the recommendation of the Chief of Engineers, may grant permission for the temporary occupation or use of any sea wall, bulkhead, jetty, dike, levee, wharf, pier, or other work built by the United States. Major alterations to a Federal flood control project, including alterations to channels and levees that change the Federal project’s authorized geometry or the hydraulic capacity, would require a Corps permit.

12.2.2 State of California

The State regulatory setting describes the Central Valley Flood Protection Act of 2008 and the CVFPB Encroachment Permit.

Central Valley Flood Protection Act of 2008

The Flood Protection Act of 2008 has strengthened flood protection regulations in California. This legislation requires DWR and CVFPB to prepare and adopt a Central Valley Flood Protection Plan. The legislation also establishes certain flood protection requirements for local land use decision-making based on the Central Valley Flood Protection Plan. This law sets new standards for flood protection for the San Joaquin Valley area. It requires an urban level of flood protection necessary to withstand a 1 in 200 chance of a flood event occurring in any given year (200-year flood) for areas developed or planned to have a population of at least 10,000. Under the Central Valley Flood Protection Plan, the State is also considering structural and nonstructural options for rural-agricultural and small communities for protection from a 100-year (1% annual chance) flood.

Central Valley Flood Protection Board Encroachment Permit

Under Title 23 of the California Code of Regulations, the CVFPB issues encroachment permits to maintain the integrity and safety of flood control project levees and floodways that were constructed according to flood control plans adopted by CVFPB or the California Legislature. The CVFPB has jurisdiction over the levee section, the waterward area between project levees, a 10-foot-wide strip adjacent to the landward levee toe, within 30 feet of the top of the banks of unleveed project channels, and within designated floodways adopted by the CVFPB. Activities outside of these limits that could adversely affect the flood control project also fall under the jurisdiction of the CVFPB. In accordance with the provisions of Title 33, CFR Section 208.10, all permit requests for construction of improvements of any nature within the limits of a Federal project right-of-way would be referred to the Corps District Engineer for review.

Project-level actions will require work along the San Joaquin River in areas that may be subject to Title 23 because the river is managed for flood control and thus contains features subject to the jurisdiction of CVFPB. The San Joaquin River is a regulated stream and the proposed action could have an effect on the flood control functions of project levees just east and north of the Chowchilla Bifurcation Structure or downstream project levees. Project proponents will secure encroachment permits, as needed, to satisfy Title 23 before performing any work along relevant reaches of the San Joaquin River that contain flood control features subject to CVFPB jurisdiction.

12.2.3 Regional and Local

Local plans and policies include those designated in county general plans.

Fresno County General Plan

The Fresno County General Plan Policy Document (Fresno County 2000) outlines several policies for flood management.

- Policy HS-C.2 requires that the design and location of dams and levees be in accordance with applicable design standards and specifications and accepted design and construction practices.
- Policy HS-C.6 indicates that the County shall promote flood control measures that maintain natural conditions within the 100-year floodplain of rivers and streams

and, to the extent possible, combine flood control, recreation, water quality, and open space functions.

- Policy HS-C.7 indicates that the County shall continue to participate in the Federal Flood Insurance Program by ensuring compliance with applicable requirements.
- Policy HC-C.10 required that placement of structures and/or floodproofing be done in a manner that will not cause floodwaters to be diverted onto adjacent property, increase flood hazards to other property, or otherwise adversely affect other property.

Madera County General Plan

The Madera County General Plan Policy Document (Madera County 1995) outlines several policies for flood management.

- Policy 6.B.1 requires flood-proofing of structures in areas subject to flooding.
- Policy 6.B.3 restricts uses in designated floodways to those that are tolerant of occasional flooding and do not restrict or alter flow of flood waters.
- Policy 6.B.4 requires that development within areas subject to 100-year floods be designed and constructed in a manner that will not cause floodwaters to be diverted onto adjacent property or increase flood hazards to other areas.

12.3 Environmental Consequences and Mitigation Measures

12.3.1 Impact Assessment Methodology

This section describes the impact assessment methodology for hydrology – flood management resources in the Project area. Assessment included the application of quantitative modeling results and qualitative assessments. The assessment includes review of hydraulic modeling results performed using HEC-RAS and SRH-1D models. These models were used to forecast stages and channel and floodplain velocities for the Project alternatives. The evaluation of flood management impacts considers how proposed changes associated with Project alternatives would affect flooding in Reach 2B and the Restoration Area.

12.3.2 Significance Criteria

The thresholds of significance for impacts are based on the Environmental Checklist Form in Appendix G of the California Environmental Quality Act (CEQA) Guidelines, as amended. These thresholds also encompass the factors taken into account under the National Environmental Policy Act (NEPA) to determine the significance of an action in terms of its context and the intensity of its effects. Impacts to flood management resulting from the Project would be significant if they would cause any of the following:

- Expose people or structures to a significant risk of loss, injury, or death involving flooding, including flooding as a result of the failure or a levee or dam, including:

  - Increase risk of levee failure due to underseepage, through-seepage, or associated landside slope stability mechanisms (this is described in Chapter 13.0, "Hydrology–Groundwater").
  - Increase risk of levee failure due to erosion or associated landside slope stability mechanisms.
- Substantially reduce opportunities for levee and flood system facilities inspection and maintenance.
- Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site.
- Place within a 100-year flood hazard area structures that would impede or redirect flood flows.
- Place housing 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.

Significance standards are relative to both existing conditions (2009) and future conditions (2035) unless stated otherwise.

12.3.3 Impacts and Mitigation Measures

This section provides a project-level evaluation of direct and indirect effects of the Project Alternatives on flood management. It includes analyses of potential effects relative to No-Action conditions in accordance with NEPA and potential impacts compared to existing conditions to meet CEQA requirements. The analysis is organized by project alternative with specific impact topics numbered sequentially under each alternative. With respect to flood management, the environmental impact issues and concerns are:

1. Expose People or Structures to a Significant Risk of Loss, Injury, or Death Involving Flooding.
2. Substantially Reduce Opportunities for Levee and Flood System Facilities Inspection and Maintenance.
3. Substantially Alter Existing Drainage Patterns or Substantially Increase the Rate or Amount of Surface Runoff in a Manner Which Would Result in Flooding On- or Off-Site.
4. Placement of Structures Within a 100-Year Flood Hazard Area that Would Adversely Impede or Redirect Flood Flows.

Other flood-related issues covered in the Program Environmental Impact Statement/Report (PEIS/R) are not covered here because they are programmatic in nature and/or are not relevant to the Project area. The Project does not involve the construction or placement of any housing within a 100-year flood hazard zone. Therefore, this impact is not discussed further.

No-Action Alternative

Under the No-Action Alternative, the Project would not be implemented and none of the Project features would be developed in Reach 2B of the San Joaquin River. However, other proposed actions under the San Joaquin River Restoration Program (SJRRP) would be implemented, including habitat restoration, augmentation of river flows, and reintroduction of salmon. Without the Project in Reach 2B, however, these activities would not achieve the Settlement goals. This section describes the impacts of the No-Action alternative. The analysis is a comparison to existing conditions, and no mitigation is required for No-Action.

Impact FLD-1 (No-Action Alternative*): Expose People or Structures to a Significant Risk of Loss, Injury, or Death Involving Flooding.* Under the No-Action Alternative, the Project would not be implemented, improvements in Reach 2B flood control structures or levees would not occur, and Project areas protected by local levees would remain within the FEMA-designated 100-year flood hazard area. Under existing conditions, the effective flood capacity of Reach 2B is less than the design capacity of 2,500 cfs, which implies that the channel capacity of Reach 2B has been reduced since construction of the existing levees. Reach 2B can functionally pass about 1,600 cfs of San Joaquin River flood flows with the boards out at Mendota Dam, and because of this, San Joaquin River flood flows that may otherwise have been routed through Reach 2B are instead routed through the Chowchilla Bypass. Therefore, the flood system is not operating as envisioned in the flood manual, potentially causing more flood damage to the system and adjacent landowners. This trend of decreasing channel capacity may continue under the No-Action Alternative. This impact is **potentially significant**. No mitigation is required for No-Action.

Impact FLD-2 (No-Action Alternative): *Substantially Reduce Opportunities for Levee and Flood System Facilities Inspection and Maintenance.* Under the No-Action Alternative, the Project would not be implemented and there would be no interruptions to flood system facility inspections and maintenance in Reach 2B. Restoration Flows could cause an increase in sediment deposition above the Chowchilla Bypass control structures requiring additional maintenance activities at this location. This is only one of several control structures maintained in the flood control system and increases in maintenance activities at this location are expected to be minor compared to maintenance requirements for the overall flood control system. This impact would be **less than significant**.

Impact FLD-3 (No-Action Alternative): *Substantially Alter Existing Drainage Patterns or Substantially Increase the Rate or Amount of Surface Runoff in a Manner Which Would Result in Flooding On- or Off-Site.* Under the No-Action Alternative, existing levees and floodplain width would be maintained. There would not be a change to existing drainage patterns that would affect the rate of surface water runoff or infiltration. There would be **no impact**.

Impact FLD-4 (No-Action Alternative): *Placement of Structures Within a 100-Year Flood Hazard Area that Would Adversely Impede or Redirect Flood Flows.* Under the No-Action Alternative, the Project would not be implemented and no additional Project structures would be placed within the 100-year flood hazard area. No actions would be undertaken that would cause impacts under the No-Action Alternative. There would be **no impact.**

Alternative A (Compact Bypass with Narrow Floodplain and South Canal)

Alternative A would include construction of Project facilities, including a Compact Bypass channel, a new levee system encompassing the river channel with a narrow floodplain, and the South Canal. Other key features include construction of the Mendota Pool Dike (separating the San Joaquin River and Mendota Pool), a fish barrier below Mendota Dam, and the South Canal bifurcation structure with fish passage facility and fish screen, modification of the San Mateo Avenue crossing, and the removal of the San Joaquin River control structure at the Chowchilla Bifurcation Structure. Construction activity is expected to occur intermittently over an approximate 132-month timeframe.

Impact FLD-1 (Alternative A*): Expose People or Structures to a Significant Risk of Loss, Injury, or Death Involving Flooding.* The documented existing design capacity of Reach 2B is about 2,500 cfs. Compared to the No-Action Alternative, Alternative A would increase the capacity of Reach 2B to 4,500 cfs with 3 feet of freeboard. This increase in conveyance capacity in Reach 2B provides flood management agencies additional flexibility in how flood flows are managed in the lower San Joaquin River system.

The existing design capacity of Reach 3 is 4,500 cfs. Reach 3 can receive flood flow from the Kings River system through the James Bypass and Fresno Slough or can receive flood flow from the San Joaquin River system through Reach 2B. According to flood management guidelines, water from the Kings River system has priority to use available capacity in the San Joaquin River below Mendota Pool. If 4,500 cfs of flow is conveyed through Fresno Slough, there would be no flood flows conveyed through Reach 2B because there would be no additional capacity in Reach 3. If there is a reduced need for flood flow conveyance through Fresno Slough, Reach 2B is used to convey flood flows. If there is no need to convey flood flows from Fresno Slough, up to 4,500 cfs of flood flows could be conveyed through Reach 2B under Alternative A. This would reduce the amount of flow routed through Chowchilla Bypass, potentially reducing flood damage to the system and adjacent landowners in downstream areas.

Modifications to existing Federal flood control features or flood control operations in the Project area would require approval by the Corps and/or the CVFPB. Modifications to the Chowchilla Bifurcation Structure would not be allowed to affect flood control operations or the LSJLD's ability to route flood flows. However, the LSJLD may choose to use the additional capacity in Reach 2B to carry flood flows.

Flood management agencies have ultimate discretion in directing flood flows. If flood management guidelines are revised subsequent to implementation of the Project, there is a potential that flood flows through Reach 2B could have priority over flood flows from Fresno Slough. However, this is unlikely to occur because overall flood flow conveyance in the system would not be optimized. (If flood flow through Reach 2B was prioritized over Fresno Slough flows, Chowchilla Bypass would have 2,000 cfs of additional flood conveyance capacity.)

The increase in Reach 2B capacity would reduce the risk of flooding in Reach 2B, a beneficial effect for Reach 2B. The Project would build new levees to Corps standards, which would also be a beneficial effect associated with flood management. Under this alternative, the chance of a levee failure in Reach 2B during a large storm event would decrease. Although not observed during recent large flood events, a levee failure in Reach 2B would reduce potential levee failure in reaches downstream of Reach 2B. To the extent that this could occur, reducing the probability of Reach 2B levees failing in the future could increase the probability of downstream levee failure and flooding. However, the likelihood of this happening is low and downstream interests cannot claim flood protection benefits by relying on failure of upstream facilities, nor can they claim they are harmed if the upstream failure does not occur.

The mechanism for increased probability of levee failure would be from an increased frequency of large flows in downstream reaches. Without the Project, only flows up to 2,500 cfs from Reach 2A or flows up to 4,500 cfs from Fresno Slough could be directed through Reach 2B. However, under Alternative A, up to 4,500 cfs of flood or Restoration Flows could be routed from Reach 2A into Reach 3. Therefore, under Alternative A, flows greater than 2,500 cfs but within the Reach 3 capacity could occur more frequently. Potential levee damage from the increased frequency of larger flows would primarily be from erosion, and Program monitoring and maintenance efforts would repair erosion on a regular basis to lessen the likelihood of this leading to levee failures in the Program Restoration Area downstream of Reach 2B.

When comparing Alternative A to existing conditions, impacts would be similar to those described in the preceding paragraphs (i.e., the comparison of Alternative A to the No-Action Alternative). To evaluate the potential for redirected flood risk, flows in Reach 3 with and without the restoration project (inclusive of both Program and Project elements) were estimated for the period from October 1921 through September 30, 2003, using data from the San Joaquin River Restoration Daily Flow Model developed in RiverWare (Reclamation 2012). These data were used to calculate the daily average flow duration and annual maximum flows from Reach 2B to Reach 3. The flow duration curve is a flow exceedance probability curve (Figure 12-3), which shows the percentage of time that the stream flow is likely to equal or exceed a flow value of interest. For example, in Figure 12-3, a flow of 100 cfs from Reach 2B to Reach 3 is exceeded 80 percent of the time under existing conditions and 98 percent of the time under Restoration Flow conditions. In other words, under Restoration Flows, flow from Reach 2B to Reach 3 will be equal to or greater than 100 cfs, 98 percent of the time. A flow of 4,500 cfs (the current capacity of Reach 3) is exceeded less than 0.5 percent of the time under existing conditions. This would increase to about 2.5 percent of the time under Restoration Flows.

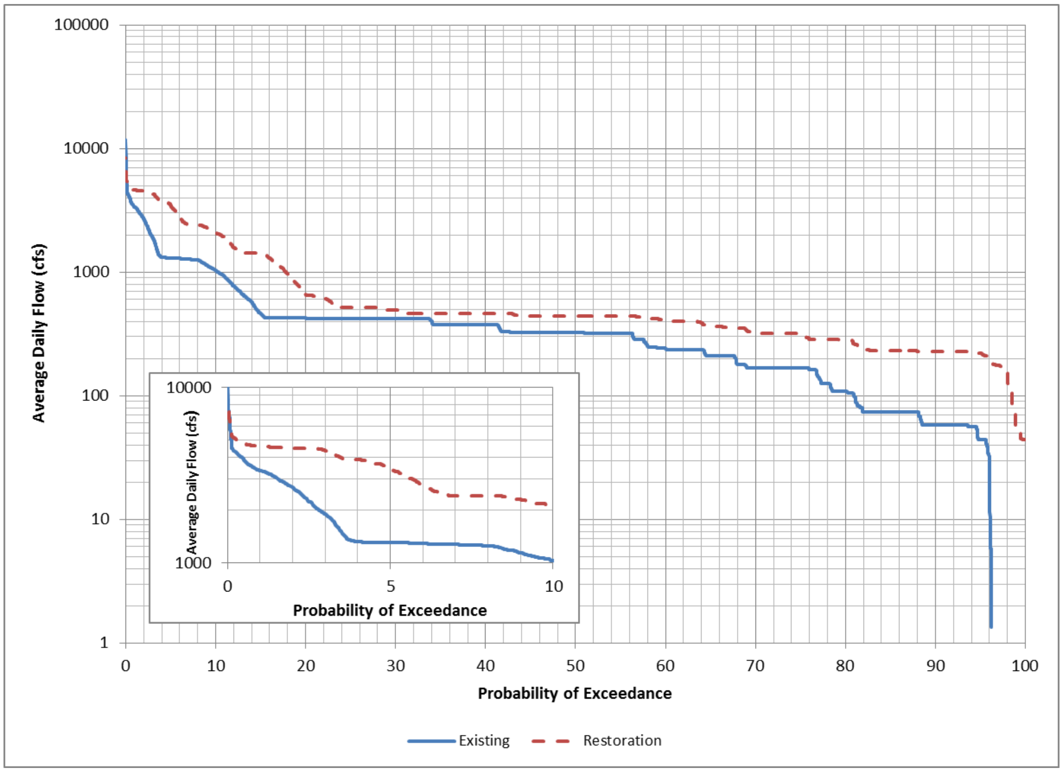


Figure 12-3.
Flow Duration Curve for Flows from Reach 2B

Annual maximum flow is the maximum flow that occurs within any year. It is the flow typically used for the design of levees and other flood control facilities. Though the maximum instantaneous flow rather than the daily average flow is usually used for design on large rivers, such as the San Joaquin River, the two are typically similar. Figure 12-4 shows the flood frequency curve for Reach 3 with and without Restoration Flows. With Restoration Flows, the size of smaller events (less than a 2 percent annual exceedance probability or 50-year event) would increase but for larger, less frequent, flood events the flow would decrease. For example, the 5-year event (20 percent annual exceedance probability) would increase from a little over 2,000 cfs to over 4,000 cfs with Restoration Flows, but the 1 percent annual exceedance flow (100-year event) would decrease from 9,000 cfs to 7,000 cfs.

Overall, increasing the design capacity of Reach 2B to convey Restoration Flows would have a neutral effect. Because the increase in the frequency of smaller, low-risk events would be offset, or partially offset, by a decrease in larger, high-risk events and because Program monitoring and maintenance efforts would repair levee erosion from Restoration Flows, impacts of Alternative A would be **less than significant**.

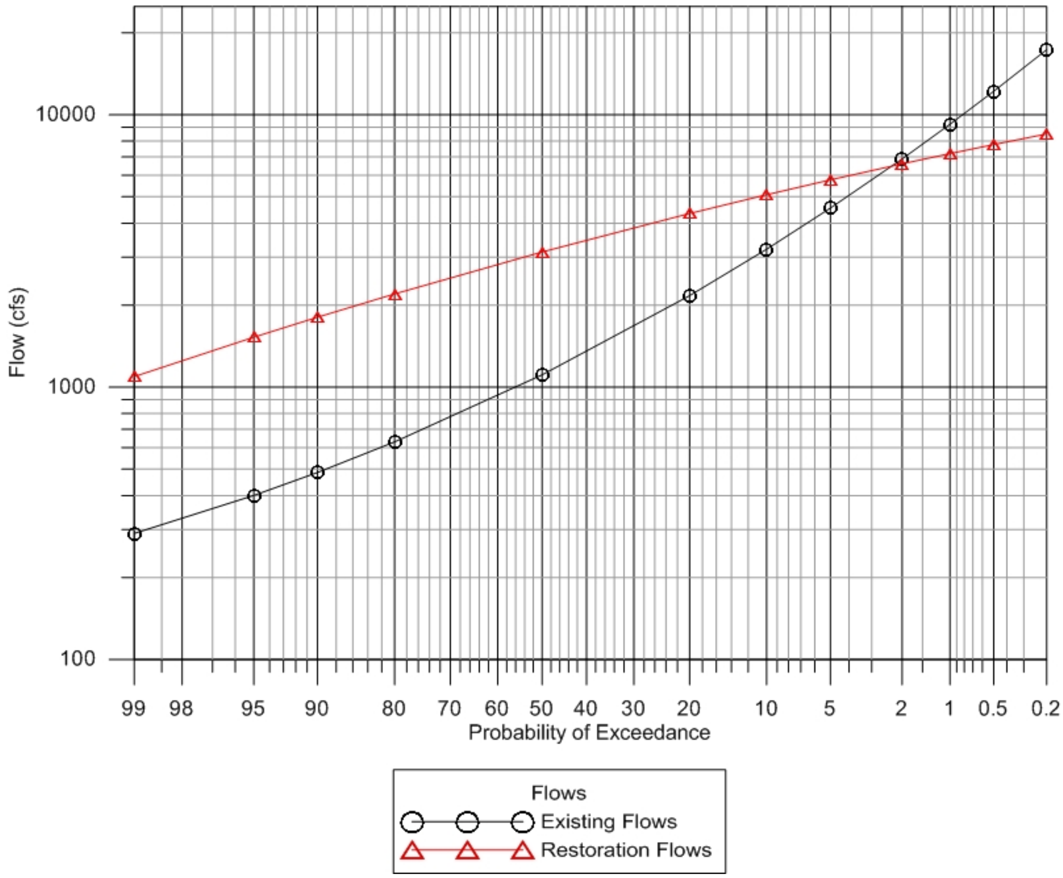


Figure 12-4.
Flood Frequency Curve for Flows from Reach 2B

Impact FLD-2 (Alternative A): ***Substantially Reduce Opportunities for Levee and Flood System Facilities Inspection and Maintenance.*** LSJLD is responsible for operation and maintenance and emergency management of State flood control facilities within the Project vicinity including maintenance of levees, channel bottoms, and flood management facilities. Operations and maintenance activities include vegetation management activities, sediment management and removal activities, cleaning of screens and trash racks on facilities, opening and closing gates and flap gates in the bypass systems, and flood watch. Important facilities maintained by the district include the Chowchilla Bypass, the Eastside Bypass, and the Mariposa Bypass. The LSJLD is not responsible for operation and maintenance of privately owned levees.

Compared to the No-Action Alternative, construction activities may temporarily limit access to levees and facilities for maintenance and inspection staff. However, construction activities would not completely impede inspection and maintenance activities; minor coordination of such activities would be required. New levees that are constructed would be accessible. Therefore, potential short-term effects would be negligible.

The Project includes long-term operations, maintenance, and monitoring of the proposed facilities and features (see Section 2.2.4). Levees would require access for vegetation management, levee inspections, and levee restoration. Control structures would require access for annual operating maintenance for control gates, lubricating the fittings, greasing and inspecting the motors, replacing parts and equipment, in-channel sediment removal in the structure vicinity, and cleaning the trash rack. Fish passage facilities, fish screens, and fish barriers would also need to be inspected, operated, and maintained. Monitoring activities would require access for physical and nonphysical activities within the Project area, including flow monitoring, groundwater level monitoring, aerial and topographic surveys, vegetation surveys, sediment mobilization monitoring, and monitoring of passage and screening effectiveness. Implementation of these operation, maintenance, and monitoring activities is part of the Project and access would be provided to maintenance and inspection staff. Therefore, long-term access and opportunities for levee and flood system facilities inspection and maintenance would be provided.

When comparing Alternative A to existing conditions, impacts would be similar to those described in the preceding paragraphs (i.e., the comparison of Alternative A to the No-Action Alternative). This impact would be **less than significant**.

Impact FLD-3 (Alternative A): ***Substantially Alter Existing Drainage Patterns or Substantially Increase the Rate or Amount of Surface Runoff in a Manner Which Would Result in Flooding On- or Off-Site.*** Under Alternative A, setback levees would be constructed to widen the floodplain. The floodplain would also be graded in locations to set it at the elevation desired for restoration. Compared to the No-Action Alternative, these activities would alter local drainage patterns and possibly affect existing drainage outside the mainstem of the river by blocking channels or by redirecting overland flow that otherwise would have drained into the Project footprint. This would potentially cause ponding on the landward side of levees. However, the construction of new levees would include seepage control measures, inspection trenches, maintenance roads, and drainage trenches to direct off-site drainage, as well as the realignment or modification of existing drainage channels (see Section 2.2.4). Surface drainage ditches would only be intended to capture and direct runoff; they are not intended to address groundwater seepage or through-levee seepage. These actions would reduce potential effects to negligible levels.

When comparing Alternative A to existing conditions, impacts would be similar to those described in the preceding paragraph (i.e., the comparison of Alternative A to the No-Action Alternative). This impact would be **less than significant.**

Impact FLD-4 (Alternative A): ***Placement of Structures Within a 100-Year Flood Hazard Area that Would Adversely Impede or Redirect Flood Flows.*** The major facilities that would be constructed within the 100-year flood hazard area under Alternative A include the Compact Bypass channel, Mendota Pool Dike, modifications to the San Mateo Avenue crossing, a diversion structure for the South Canal, modifications to the Chowchilla Bifurcation Structure, and fish passage facilities.

Compared to the No-Action Alternative diversion structures and fish passage facilities could create localized backwater and redirection effects. These effects would be considered during Project design. Structures would be designed in general accordance with Reclamation Design Standards No. 3 for water conveyance facilities, fish facilities, and roads and bridges, applicable design codes, and commonly accepted industry standards. Levee design would be based on the Corps *Engineer Manual 1110-2-1913 Design and Construction of Levees* guidelines (Corps 2000a) and *Engineer Manual 1110-2-301 Guidelines for Landscape Planting and Vegetation Management at Floodwalls, Levees, & Embankment Dams* (Corps 2000b).

Localized backwater and redirection effects at Project structures would be considered during design of levee heights. Levees would be designed to maintain 3 feet of freeboard on the levees at 4,500 cfs (see Section 2.2.4). Therefore, flooding effects would be negligible.

When comparing Alternative A to existing conditions, impacts would be similar to those described in the preceding paragraphs (i.e., the comparison of Alternative A to the No-Action Alternative). This impact would be **less than significant.**

Alternative B (Compact Bypass with Consensus-Based Floodplain and Bifurcation Structure), the Preferred Alternative

Alternative B would include construction of Project features including a Compact Bypass channel, a new levee system with a wide, consensus-based floodplain encompassing the river channel, and the Compact Bypass Bifurcation Structure with fish passage facility and fish screen. Other key features include construction of a fish passage facility at the San Joaquin River control structure at the Chowchilla Bifurcation Structure, the re-route of Drive 10 ½ (across the Compact Bypass control structure), and removal of the San Mateo Avenue crossing. Construction activity is expected to occur intermittently over an approximate 157-month timeframe.

Impact FLD-1 (Alternative B*): Expose People or Structures to a Significant Risk of Loss, Injury, or Death Involving Flooding.* Refer to Impact FLD-1 (Alternative A). Potential impacts of Alternative B would be the same as potential impacts of Alternative A with the following exception. The Compact Bypass design in Alternative B includes fewer grade control structures than the other alternatives, which would initiate channel bed erosion in Reach 2B to remove sediment that has been deposited in the San Joaquin River arm of Mendota Pool. The channel bed erosion in Reach 2B would result in sediment deposition in the Reach 3 channel for approximately 1 mile downstream of the Compact Bypass (RM 203). The maximum estimated water surface increase resulting from this sedimentation is approximately 0.25 feet. Levee improvements would be extended in the upper portion of Reach 3 to approximately RM 203 to offset this water surface increase if needed to maintain 3 feet of freeboard. This impact would be **less than significant**.

Impact FLD-2 (Alternative B): *Substantially Reduce Opportunities for Levee and Flood System Facilities Inspection and Maintenance.* Refer to Impact FLD-2

(Alternative A). Potential impacts of Alternative B would be the same as potential impacts of Alternative A. This impact would be **less than significant.**

Impact FLD-3 (Alternative B): ***Substantially Alter Existing Drainage Patterns or Substantially Increase the Rate or Amount of Surface Runoff in a Manner Which Would Result in Flooding On- or Off-Site.*** Refer to Impact FLD-3 (Alternative A). Potential impacts of Alternative B would be the same as potential impacts of Alternative A. This impact would be **less than significant.**

Impact FLD-4 (Alternative B): ***Placement of Structures Within a 100-Year Flood Hazard Area that Would Adversely Impede or Redirect Flood Flows.*** Refer to Impact FLD-4 (Alternative A). Potential impacts of Alternative B would be the same as potential impacts of Alternative A, with the following exceptions. The major facilities that would be constructed within the 100-year flood hazard area include the Compact Bypass channel, Compact Bypass Bifurcation Structure, and fish passage facilities, and the San Mateo Avenue crossing would be removed. Localized backwater and redirection effects at Project structures would be considered during design of levee heights. Therefore, flooding effects would be negligible. This impact would be **less than significant.**

Alternative C (Fresno Slough Dam with Narrow Floodplain and Short Canal)

Alternative C would include construction of Project features including Fresno Slough Dam, a new levee system with a narrow floodplain encompassing the river channel, and the Short Canal. Other key features include construction of the Mendota Dam fish passage facility, fish barrier below Fresno Slough Dam, the Short Canal control structure and fish screen, the Chowchilla Bifurcation Structure fish passage facility, modification of San Mateo Avenue crossing, and Main Canal and Helm Ditch relocations. Construction activity is expected to occur intermittently over an approximate 133-month timeframe.

Impact FLD-1 (Alternative C*):* ***Expose People or Structures to a Significant Risk of Loss, Injury, or Death Involving Flooding.*** Refer to Impact FLD-1 (Alternative A). Potential impacts of Alternative C would be the same as potential impacts of Alternative A. This impact would be **less than significant**.

Impact FLD-2 (Alternative C): ***Substantially Reduce Opportunities for Levee and Flood System Facilities Inspection and Maintenance.*** Refer to Impact FLD-2 (Alternative A). Potential impacts of Alternative C would be the same as potential impacts of Alternative A. This impact would be **less than significant.**

Impact FLD-3 (Alternative C): ***Substantially Alter Existing Drainage Patterns or Substantially Increase the Rate or Amount of Surface Runoff in a Manner Which Would Result in Flooding On- or Off-Site.*** Refer to Impact FLD-3 (Alternative A). Potential impacts of Alternative C would be the same as potential impacts of Alternative A. This impact would be **less than significant.**

Impact FLD-4 (Alternative C): ***Placement of Structures Within a 100-Year Flood Hazard Area that Would Adversely Impede or Redirect Flood Flows.*** Refer to Impact

FLD-4 (Alternative A). Potential impacts of Alternative C would be the same as potential impacts of Alternative A, with the following exceptions. The major facilities that would be constructed within the 100-year flood hazard area include Fresno Slough Dam, Short Canal control structure, fish passage facilities, modification of San Mateo Avenue crossing, and Main Canal and Helm Ditch relocations. The new dam on Fresno Slough would back up Fresno Slough to a similar level as it is presently backed up by Mendota Dam. The Fresno Slough Dam would have a reinforced concrete spillway. The spillway structure would be comprised of multiple gates, which serve to control the flow of water from the Mendota Pool to the San Joaquin River (see Section 2.2.7). Therefore, flooding effects would be negligible**.** This impact would be **less than significant.**

Alternative D (Fresno Slough Dam with Wide Floodplain and North Canal)

Alternative D would include construction of Project features including Fresno Slough Dam, a new levee system with a wide floodplain encompassing the river channel, and the North Canal. Other key features include construction of the Mendota Dam fish passage facility, a fish barrier below Fresno Slough Dam, the North Canal bifurcation structure with fish passage facility and fish screen, removal of the San Joaquin River control structure at the Chowchilla Bifurcation Structure, removal of San Mateo Avenue crossing, and Main Canal and Helm Ditch relocations. Construction activity is expected to occur intermittently over an approximate 158-month timeframe.

Impact FLD-1 (Alternative D*): Expose People or Structures to a Significant Risk of Loss, Injury, or Death Involving Flooding.* Refer to Impact FLD-1 (Alternative A). Potential impacts of Alternative D would be the same as potential impacts of Alternative A. This impact would be **less than significant.**

Impact FLD-2 (Alternative D): *Substantially Reduce Opportunities for Levee and Flood System Facilities Inspection and Maintenance.* Refer to Impact FLD-2 (Alternative A). Potential impacts of Alternative D would be the same as potential impacts of Alternative A. This impact would be **less than significant.**

Impact FLD-3 (Alternative D): *Substantially Alter Existing Drainage Patterns or Substantially Increase the Rate or Amount of Surface Runoff in a Manner Which Would Result in Flooding On- or Off-Site.* Refer to Impact FLD-3 (Alternative A). Potential impacts of Alternative D would be the same as potential impacts of Alternative A. This impact would be **less than significant.**

Impact FLD-4 (Alternative D): *Placement of Structures Within a 100-Year Flood Hazard Area that Would Adversely Impede or Redirect Flood Flows.* Refer to Impact FLD-4 (Alternative A). Potential impacts of Alternative D would be the same as potential impacts of Alternative A, with the following exceptions. The major facilities that would be constructed within the 100-year flood hazard area include Fresno Slough Dam, the North Canal bifurcation structure, and fish passage facilities. The riverside control structure of the Chowchilla Bifurcation Structure and the San Mateo Avenue crossing would be removed. Portions of the Main Canal and Helm Ditch would be relocated. The new dam on Fresno Slough would back up Fresno Slough to a similar level as it is presently backed up by Mendota Dam. The Fresno Slough Dam would have a reinforced concrete spillway. The spillway structure would be comprised of multiple gates, which serve to control the flow of water from the Mendota Pool to the San Joaquin River (see Section 2.2.8). Therefore, flooding effects would be negligible**.** This impact would be **less than significant.**

13.0 Hydrology – Groundwater

This section describes the environmental and regulatory settings of groundwater, including the environmental consequences and mitigation, as they pertain to implementation of Project alternatives. Groundwater resources describe the water resources related to water flowing in the subsurface through porous sediments.

13.1 Environmental Setting

The Project area is in Fresno and Madera counties, near the town of Mendota, California, as shown on Figure 1-2 of Chapter 1.0, “Introduction.” This area is located above the San Joaquin Valley Groundwater Basin.

13.1.1 Regional Setting

The San Joaquin Valley Groundwater Basin makes up the southern two-thirds of the 400-mile-long, northwest trending asymmetric trough of the Central Valley regional aquifer system in the southern extent of the Great Valley Geomorphic Province. As defined in Bulletin 118, California’s Groundwater (California Department of Water Resources [DWR] 2003), the San Joaquin Valley Groundwater Basin is comprised of two hydrologic regions, which are divided by the San Joaquin River near Reach 2B: the San Joaquin River hydrologic region to the north and the Tulare Lake hydrologic region to the south; therefore, the Project area lies within both hydrologic regions.

Groundwater Resources of San Joaquin River Hydrologic Region

The San Joaquin River hydrologic region is heavily groundwater-reliant, with groundwater making up approximately 36 percent of the annual supply for agricultural and urban uses (DWR 2014a). The San Joaquin River hydrologic region consists of surface water basins draining into the San Joaquin River system, from the Cosumnes River basin on the north through the southern boundary of the San Joaquin River watershed. Aquifers in the San Joaquin Valley Groundwater Basin are thick and typically extend to depths of up to 800 feet.

Groundwater in the San Joaquin River hydrologic region historically flowed from the valley flanks to the axis of the valley during predevelopment conditions, then north toward the Delta. In the 1920s, development of a deep-well turbine pump and increased availability of electricity led to expansion of agriculture, and ultimately declining groundwater levels between 1920 and 1950 (DWR 2003). Groundwater pumping and recharge from imported irrigation water have resulted in a change in regional flow patterns. As described in the Program Environmental Impact Statement/Report (PEIS/R) (San Joaquin River Restoration Program [SJRRP] 2011, page 12-4), flow largely occurs from areas of recharge towards areas of lower groundwater levels. Vertical movement of water in the aquifer has been altered in this region as a result of thousands of wells constructed with perforations above and below the confining unit (Corcoran Clay

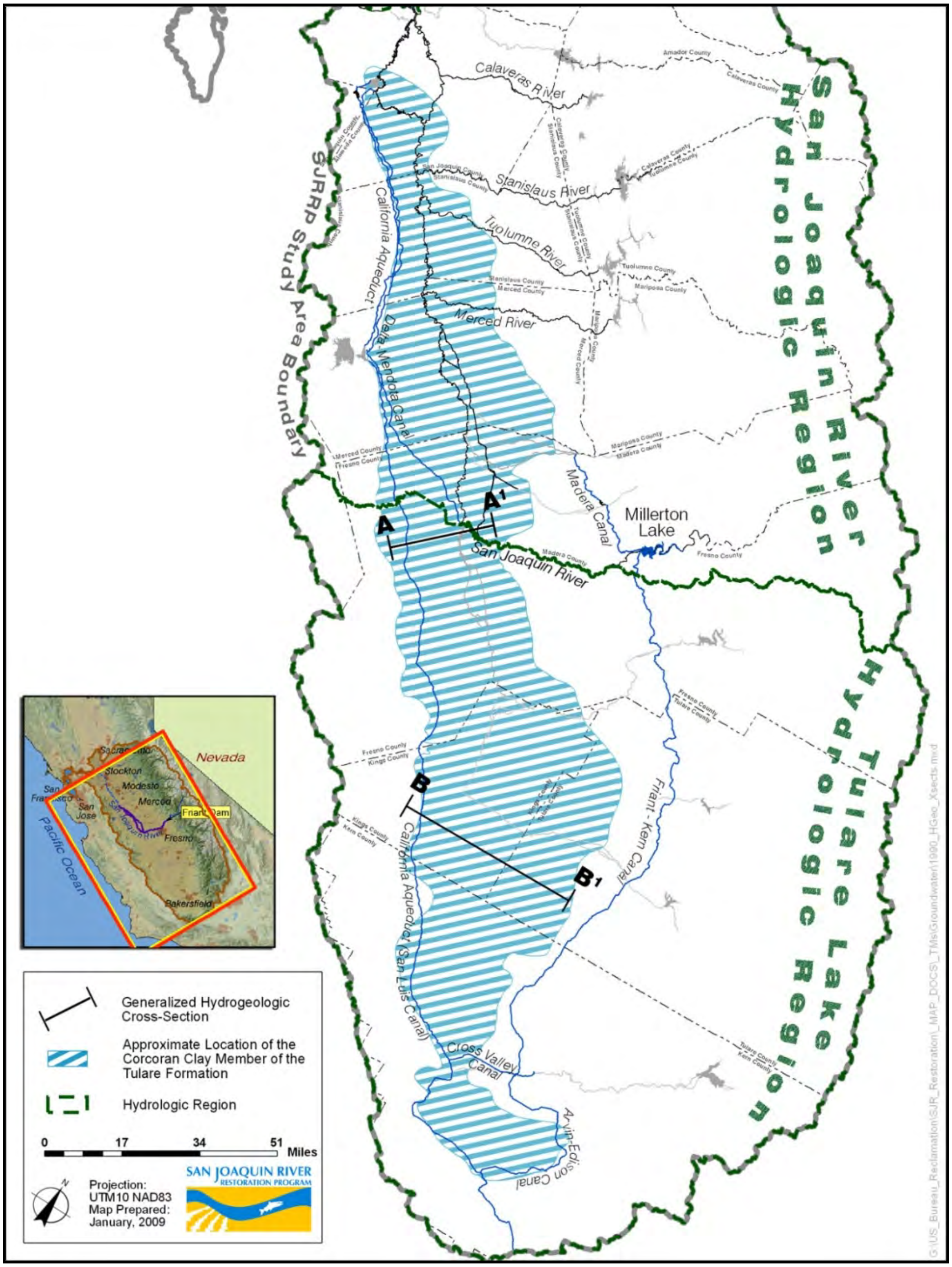
Member), where present, providing a direct hydraulic connection. This increase in vertical flow may have been partially offset by a decrease in vertical flow resulting from the inelastic compaction of fine-grained materials in the aquifer system, which occurs largely due to deep groundwater pumping. The approximate extent of the Corcoran Clay is illustrated on Figure 13-1.

The aquifer system of the San Joaquin Valley Groundwater Basin is divided into two major aquifers: an unconfined to semiconfined aquifer above the Corcoran Clay, a thick zone of clay deposited as part of the sequence of lacustrine and marsh deposits underlying Tulare Lake, and a confined aquifer beneath the Corcoran Clay. The unconfined to semiconfined aquifer can be divided into three hydrogeologic units based on the source of the sediment: Coast Range alluvium, Sierra Nevada sediments, and flood-basin deposits (see Figures 13-1 and 13-2).

The Coast Range alluvial deposits are derived largely from the erosion of marine rocks from the Coast Range. These deposits are up to 850 feet thick along the western edge of the valley and taper off to the east as they approach the center of the valley floor. The alluvial deposits contain a large proportion of silt and clay, are high in salts, and also contain elevated concentrations of selenium and other trace elements. The Sierra Nevada sediments on the eastern side of the region are derived primarily from granitic rock and consist of predominantly well-sorted micaceous sand. These deposits make up most of the total thickness of sediments along the valley axis and gradually thin to the west until pinching out near the western boundary. The Sierra Nevada sediments are relatively permeable with hydraulic conductivities three times the conductivities of the Coast Range deposits. Flood-basin deposits are relatively thin and were derived in recent time from sediments of the Coast Ranges to the west and from sediments of the Sierra Nevada to the east. These deposits occur along the center of the valley floor and consist primarily of moderately to densely compacted clays ranging between 5 and 35 feet thick.

On a regional scale, the Corcoran Clay divides the groundwater system, ranges from zero to 160 feet thick, and is found between 80 and 400 feet below the land surface. The confined aquifer is overlain by the Corcoran Clay Member of the Tulare Formation and consists of mixed origin sediments.

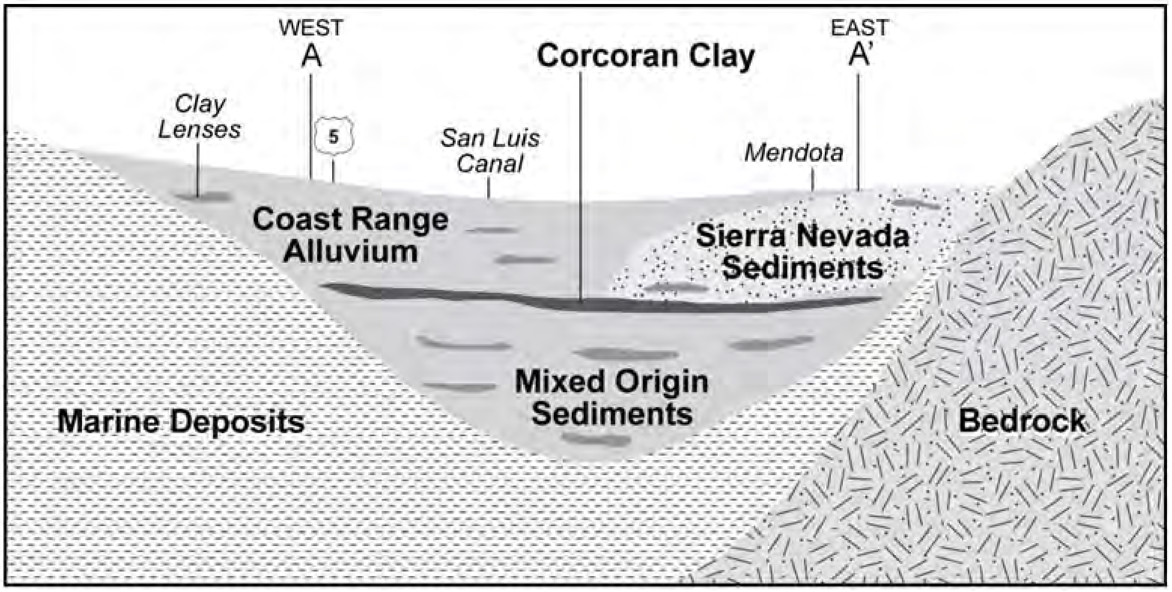
The semiconfined aquifer system of the San Joaquin Valley has historically been recharged by mountain rain and snowmelt along the valley margins. Recharge has generally occurred by stream seepage, deep percolation of rainfall, and subsurface inflow along basin boundaries. As agricultural practices expanded in the region, recharge was augmented with deep percolation of applied agricultural water and seepage from the distribution systems used to convey this water. Recharge of the lower confined aquifer consists of subsurface inflow from the valley floor and foothill areas to the east of the eastern boundary of the Corcoran Clay Member. Present information indicates that the clay layers, including the Corcoran Clay, are not continuous in some areas, and some seepage from the semiconfined aquifer above does occur through the confining layer.



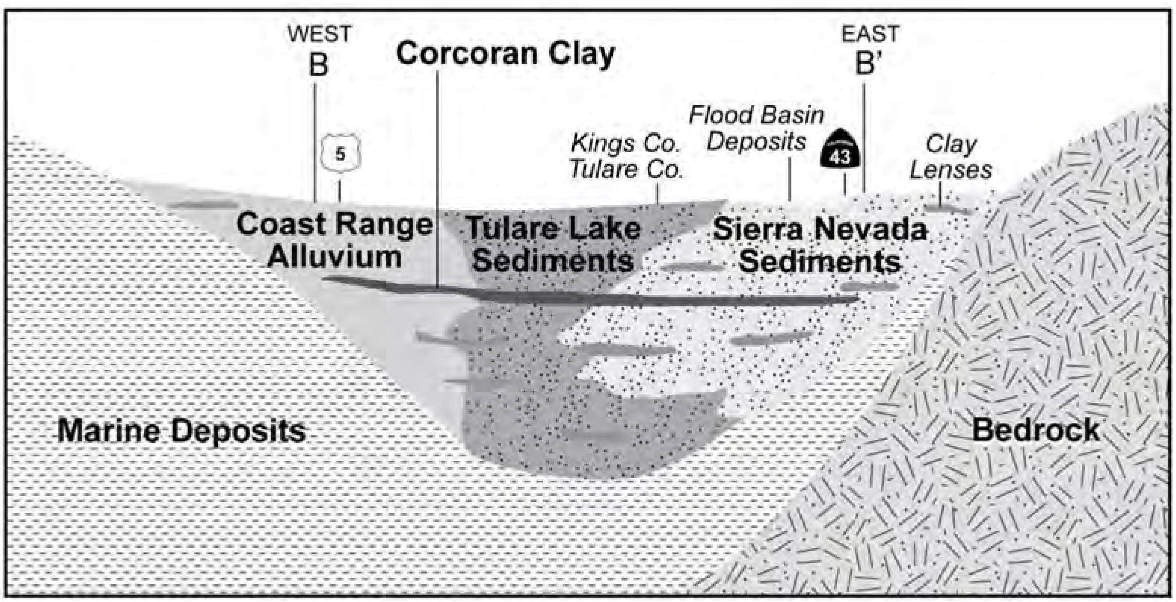
Source: SJRRP 2011

Figure 13-1.
Approximate Boundary of Corcoran Clay and Transect Lines for Hydrogeologic Cross Sections

San Joaquin River Hydrologic Region



Tulare Lake Hydrologic Region



Source: SJRRP 2011

Figure 13-2.
Generalized Hydrogeologic Cross Sections in San Joaquin River and Tulare Lake Hydrologic Regions

The decline in groundwater levels between 1920 and 1950 was as much as 40 to 80 feet in the east side and up to 30 feet in the west side of the San Joaquin River hydrologic region. In 1967, the California Aqueduct replaced groundwater as the primary source of irrigation supply to the area south of Mendota, and consequently, this area became less reliant on groundwater (DWR 2003). However, as illustrated on Figure 13-3, groundwater pumping continued to increase through time as the acreage of irrigated agriculture continued to increase.

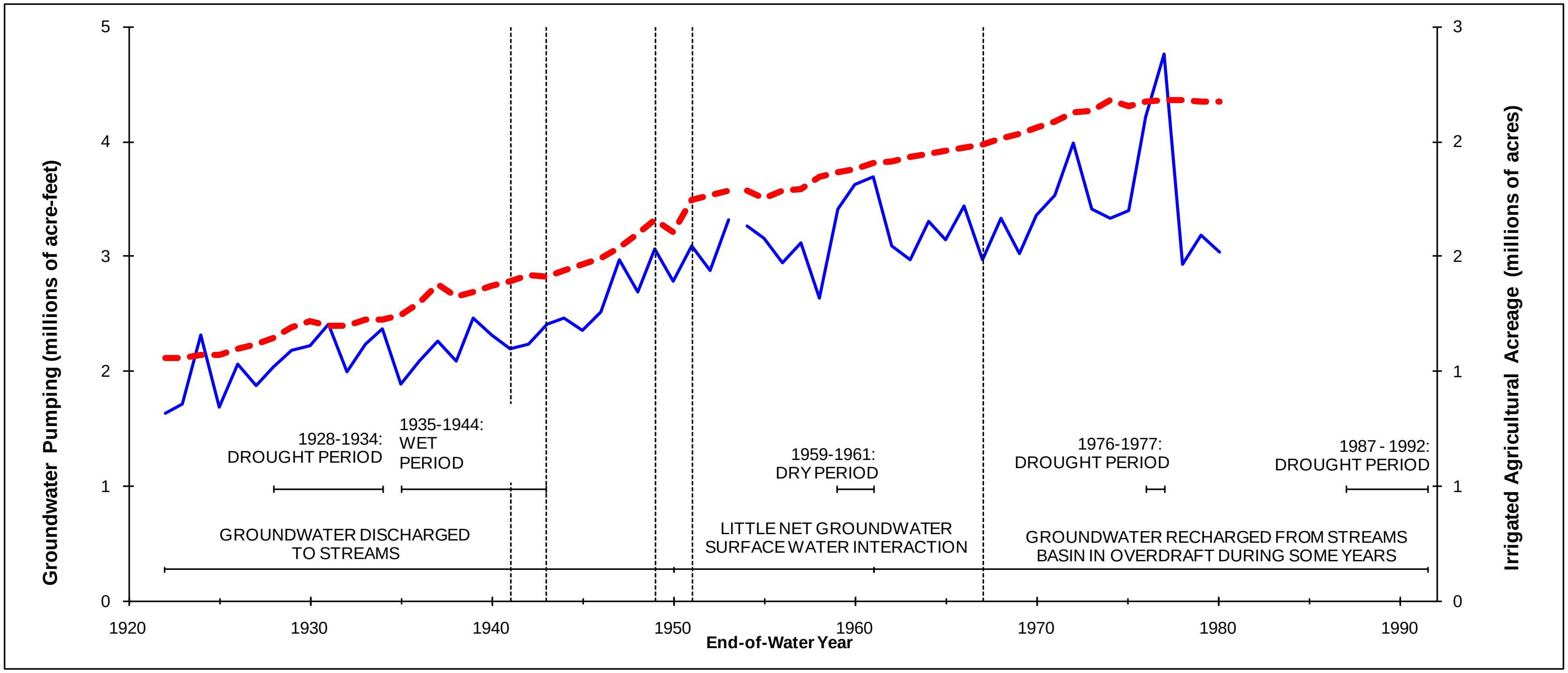
Land subsidence is the lowering of the land-surface elevation due to changes in the subsurface. Four types of land subsidence that occur in the San Joaquin Valley include: aquifer-system compaction due to groundwater level decline, near-surface hydrocompaction, subsidence due to fluid withdrawal from oil and gas fields, and subsidence caused by deep-seated tectonic movements (Sneed et al. 2013). Groundwater level decline along with surface hydrocompaction are the primary causes of land subsidence in the San Joaquin Valley. Maximum land subsidence rates occurred in the 1960s with historic lows in the San Joaquin Valley Groundwater Basin exceeding 30 feet. The southern and western areas of the valley were most affected. Figure 13-4 illustrates land subsidence contours in the San Joaquin River and Tulare Lake hydrologic regions from 1926 to 1970.

Surface water deliveries from the State Water Project and other regional conveyance facilities in the 1970s and 1980s significantly reduced the demand for groundwater for agricultural water use. Although reduced groundwater pumping and imported surface water largely diminished the subsidence problem, subsidence continued in some areas but at a slower rate, due to the time lag involved in the redistribution of pressures in the confined aquifers (DWR 2014a).

Groundwater quality in the San Joaquin Valley Groundwater Basin is variable, but is suitable for most urban and agricultural uses with the exception of some localized areas in the San Joaquin River hydrologic region. The primary constituents of concern include salinity, nitrate, arsenic, total dissolved solids (TDS), boron, chloride, selenium, dibromochloro-propane, and radon. Additional details on groundwater quality are provided in the PEIS/R (SJRRP 2011, page 12-25 to 12-29).

Inadequate drainage and accumulating salts have been persistent problems for irrigated agriculture along the west side and in parts of the east side of the San Joaquin River Hydrologic Region for more than a century. The most extensive drainage problems exist on the west side of the San Joaquin River and Tulare Lake hydrologic regions. The drainage problem developed as a result of imported water from man-made infrastructure, naturally occurring saline soils, and distinctive geology that prevents natural drainage.

Soils on the west side of the San Joaquin River Hydrologic Region are derived from marine sediments are high in salts and trace elements. Irrigation of these soils has mobilized salts and trace elements and facilitated their movement into the shallow groundwater. Much of the irrigation has been with imported water, which has resulted in inadequate drainage, rising groundwater, and increasing soil salinity.



Source: SJRRP 2011

Note:

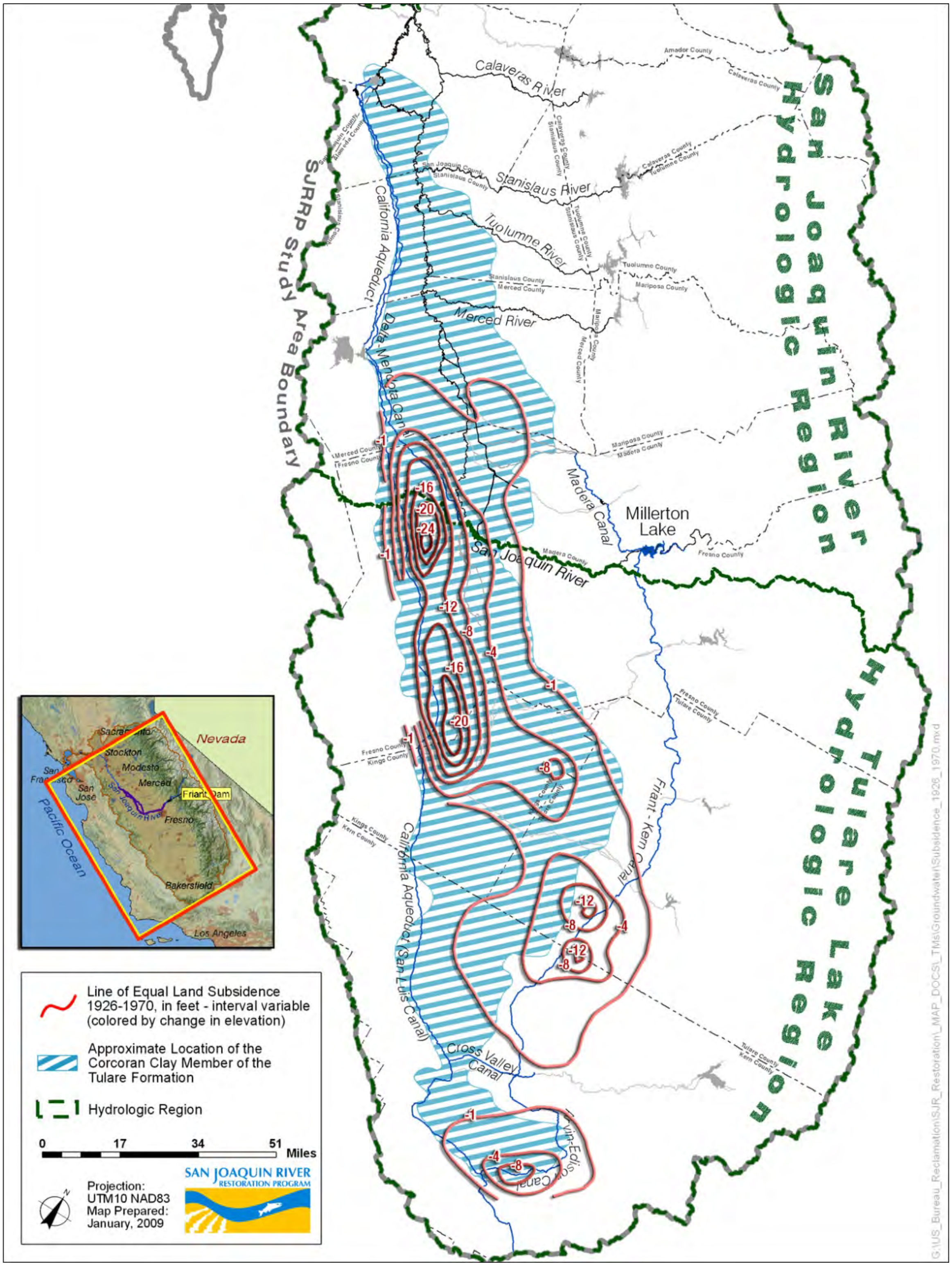
Data available for 1922 through 1980. Data developed as part of the Central Valley Ground-Surface Water Model.

Legend:

Irrigated agricultural acreage

Groundwater Pumping

Figure 13-3.
Historical Groundwater Pumping and Irrigated Agricultural Acreage for San Joaquin River Hydrologic Region



Source: SJRRP 2011

Figure 13-4.
Land Subsidence in the San Joaquin River and Tulare Lake Hydrologic Regions

In some portions of this hydrologic region, natural drainage conditions are poor, and imported irrigation water makes the upper, semiconfined aquifer (shallow groundwater table) even shallower. Therefore, groundwater levels often encroach on the root zone of agricultural crops, and subsurface drainage is often improved with constructed facilities (e.g., interceptor drains) in order to sustain irrigation.

Present problem areas were defined in the San Joaquin Valley Drainage Program (SJVDP) (DWR 2005) as locations where the water table is within 5 feet of the ground surface at any time during the year. Potential problem areas were defined in the SJVDP at locations where the water table is between 5 and 20 feet below the ground surface (DWR 2005). (The term "shallow groundwater" is referred to here as the highest zone of saturation down to a depth of approximately 20 feet below ground surface.)

Seepage and waterlogging of crops along the lower reaches of the San Joaquin River have historically been an issue. High periodic streamflows and local flooding combined with shallow groundwater near the San Joaquin River, and in the vicinity of its confluence with major tributaries, have resulted in seepage-induced waterlogging damage to low lying farmland. During flood-flow events, lateral seepage and structural stability issues with existing levees have been identified. Seepage problems were reported along the Chowchilla Bypass below the bifurcation structure on both sides of the channel in 2006.

Groundwater Resources of Tulare Lake Hydrologic Region

The Tulare Lake hydrologic region is a closed drainage basin at the south end of the San Joaquin Valley, south of the San Joaquin River watershed, encompassing surface water basins draining to the Kern Lake bed, Tulare Lake bed, and Buena Vista Lake bed. The primary aquifer in the San Joaquin Valley Groundwater Basin extends to as deep as 1,000 feet below ground surface in the southern portion of the basin (DWR 2003).

The semiconfined aquifer in the Tulare Lake hydrologic region contains the same hydrogeologic units as the San Joaquin River hydrologic region (Coast Range alluvium, Sierra Nevada sediments, and flood-basin deposits), but the region also contains Tulare Lake sediments in the axis of the valley (see Figure 13-2). The Corcoran Clay occurs at depths between 300 and 900 feet below ground surface in the Tulare Lake hydrologic region. The confined aquifer is overlain by the Corcoran Clay, but consists of the same hydrogeologic units as the unconfined to semiconfined aquifer. The Tulare Lake hydrologic region has semiconfined aquifer conditions to the west above the Corcoran Clay layer, and on the east side of the region where the clay is not present. Tulare Lake sediments present in the axis of the San Joaquin Valley have similar characteristics to flood-basin deposits present in the San Joaquin River hydrologic region (see Figure 13-2).

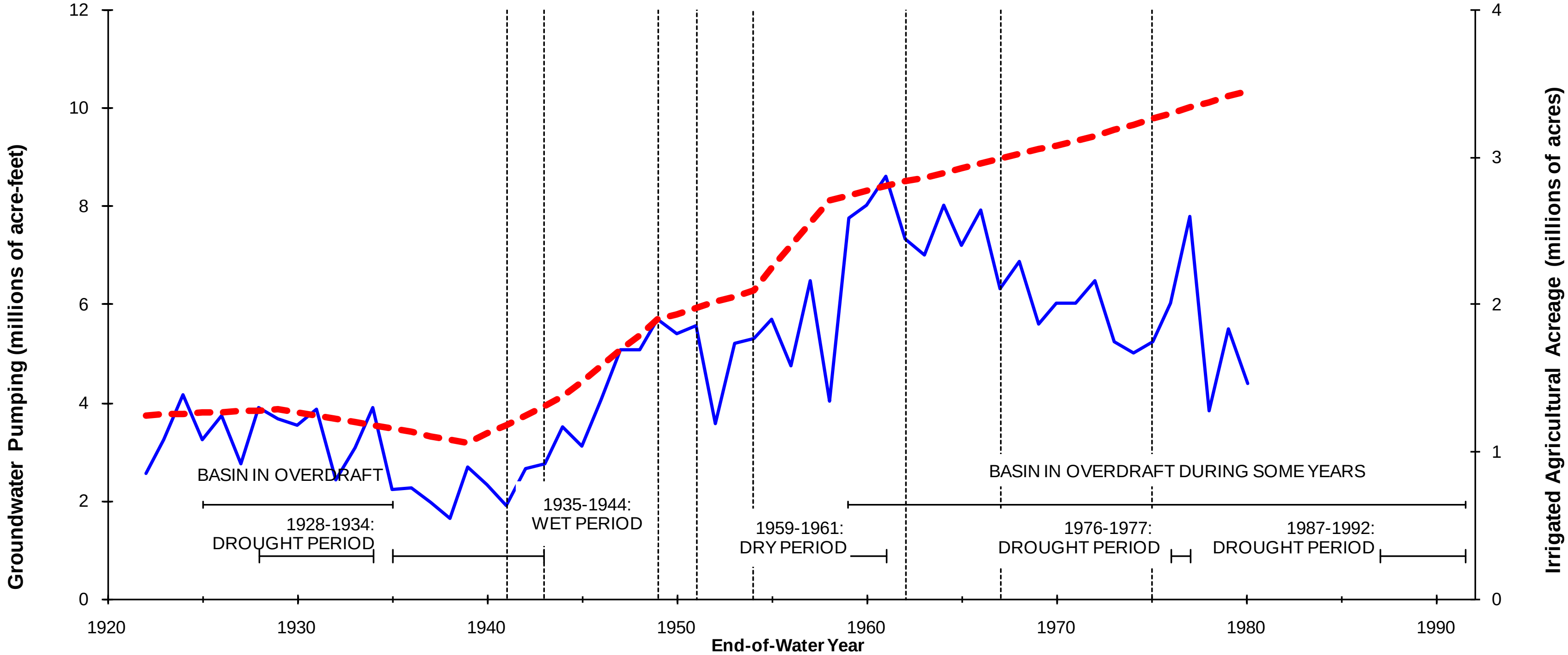
The semiconfined aquifer in the Tulare Lake hydrologic region is recharged by seepage from streams, canals, infiltration of applied water, and subsurface inflow. Precipitation is a source of recharge to the semiconfined aquifer only in wet years. Seepage from streams and canals is highly variable and depends on annual hydrologic conditions. Some of the water recharged to the semiconfined aquifer seeps through the confining clay layers, including the Corcoran Clay, which are discontinuous in some areas. Lateral flow from the semiconfined aquifer also recharges the lower confined aquifer.

The Tulare Lake hydrologic region has historically been heavily reliant on groundwater supplies. Agricultural development in the Tulare Lake hydrologic region began in the 1800s, and groundwater has been the primary source of irrigation water. Figure 13-5 illustrates changes in groundwater pumping and irrigated acreage for the Tulare Lake hydrologic region from 1922 to 1980. As described in the PEIS/R (SJRRP 2011, page 12-41), groundwater use in this hydrologic region has historically accounted for 33 percent of the total annual water supply and for 35 percent of all groundwater use in the State. Groundwater use in the hydrologic region represents approximately 10 percent of the State's total agricultural and urban water use.

Similar to the San Joaquin River hydrologic region, the Tulare Lake hydrologic region has been impacted by historical groundwater level decline and resulting land subsidence. Groundwater level decline in central Fresno County between the 1940s and 1980s has been substantial; decreasing approximately 50 to 100 feet (Williamson et al. 1989). Groundwater levels in the lower confined aquifer in the west side of the Tulare Lake hydrologic region declined as much as 400 feet from predevelopment to the 1960s (Williamson et al. 1989). Land subsidence, resulting from groundwater level decline and to a lesser extent from oil and gas withdrawal and near-surface hydrocompaction, is illustrated on Figure 13-4.

As with the San Joaquin River hydrologic region, groundwater quality in the Tulare Lake hydrologic region is variable, but in general, is suitable for most urban and agricultural uses (DWR 2003). The primary constituents of concern are salinity, nitrate, dibromochloropropane, arsenic, TDS, boron, selenium, and radon. Groundwater use for agricultural water supply is limited because of the high TDS concentrations above the Corcoran Clay in the western portion of Fresno and King Counties. Salinity and trace elements in some soil and shallow groundwater on the western side of the Tulare Lake Hydrologic Region are also of concern.

Subsurface drainage problems associated with the west side of the San Joaquin Valley Groundwater Basin extend from north to south in the Tulare Lake Hydrologic Region. The northern boundary of the Tulare Lake Hydrologic Region with the San Joaquin River Hydrologic Region is partially bounded by Reaches 1 and 2 of the San Joaquin River. Seepage problems identified in Reaches 1 and 2 influence local groundwater conditions in the Kings Subbasin in the Tulare Lake Hydrologic Region. (See the "Groundwater Resources of San Joaquin River Hydrologic Region" section above for additional discussion on seepage and waterlogging along the San Joaquin River.)



Source: SJRRP 2011

Note:

Data available from 1922 to 1980. Data developed as part of the Central Valley Ground-Surface Water Model (Reclamation et al, 1990 as cited in SJRRP 2011a)

Legend:

Groundwater Pumping

Irrigated agricultural acreage

Figure 13-5.
Historical Groundwater Pumping and Irrigated Agricultural Acreage for Tulare Lake Hydrologic Region

Conjunctive Use Programs

Conjunctive management or conjunctive use refers to the coordinated and planned use and management of both surface water and groundwater resources to maximize the availability and reliability of water supplies in a region to meet various management objectives. Water is stored in the groundwater basin that is planned to be used later by intentionally recharging the basin when excess water supply is available, for example, during years of above-average surface water supply or through the use of recycled water (DWR 2014b).

Various forms of conjunctive use are practiced throughout California. The form of conjunctive use ranges from incidental conjunctive use benefits to rigorous management programs implemented through detailed operating guidelines. For this discussion, conjunctive use is characterized as incidental conjunctive use, artificial recharge, or active substitution. These three types of conjunctive use can occur individually or may be used in conjunction with one another. Major conjunctive use programs currently in place are highlighted in DWR's *California Water Plan Update* (DWR 2014b) and some of these programs are discussed below; however, this is not a complete summary of all conjunctive use programs currently in operation or planned.

Incidental Conjunctive Use

Incidental conjunctive use occurs when an area relies on surface water when it is available and on groundwater when surface water is not available. Development of surface water storage and delivery projects by U.S. Department of the Interior, Bureau of Reclamation (Reclamation), DWR, and others has been an important factor in allowing water users to reduce groundwater pumping and build up groundwater storage for future use. Management techniques may be used to define the timing and location of surface water deliveries and groundwater pumping to maximize water supply reliability. However, groundwater pumping may increase in years of below-average precipitation and reduced availability of imported surface water supplies.

Artificial Recharge

Conjunctive use programs incorporating artificial recharge methods require a source of surface water (imported or reclaimed) that is not needed for immediate use. The surface water is placed directly into the ground by various means, including spreading ponds and injection. This water is then available for use in dry periods. This is a common practice in many areas of the State, especially in the San Joaquin River and Tulare Lake hydrologic regions.

Active Conjunctive Use Programs

Active conjunctive use programs in the San Joaquin Valley Groundwater Basin, as described in the PEIS/R (SJRRP 2011, page 12-52 to 12-57), include those listed below, the last of which is active in the Project area.

- Semitropic Water Storage District Groundwater Banking Program.
- Kern Water Bank Authority, Kern Water Bank.
- City of Fresno, Leaky Acres Water Recharge Facility.

- Farmington Groundwater Recharge Program.
- Madera Irrigation District Water Supply Enhancement Project.
- Mendota Pool, Ten-Year Exchange Agreements, Proposed Annual Water Exchange, California.

Additional Proposed Groundwater Banking Projects

Additional direct and in-lieu recharge groundwater banks have been proposed in the San Joaquin Valley by Friant Division long-term contractors and non-Friant Division contractors. These proposed projects are listed in the PEIS/R (SJRRP 2011, page 12-56 to 12-57).

13.1.2 Project Setting

Delta-Mendota Subbasin

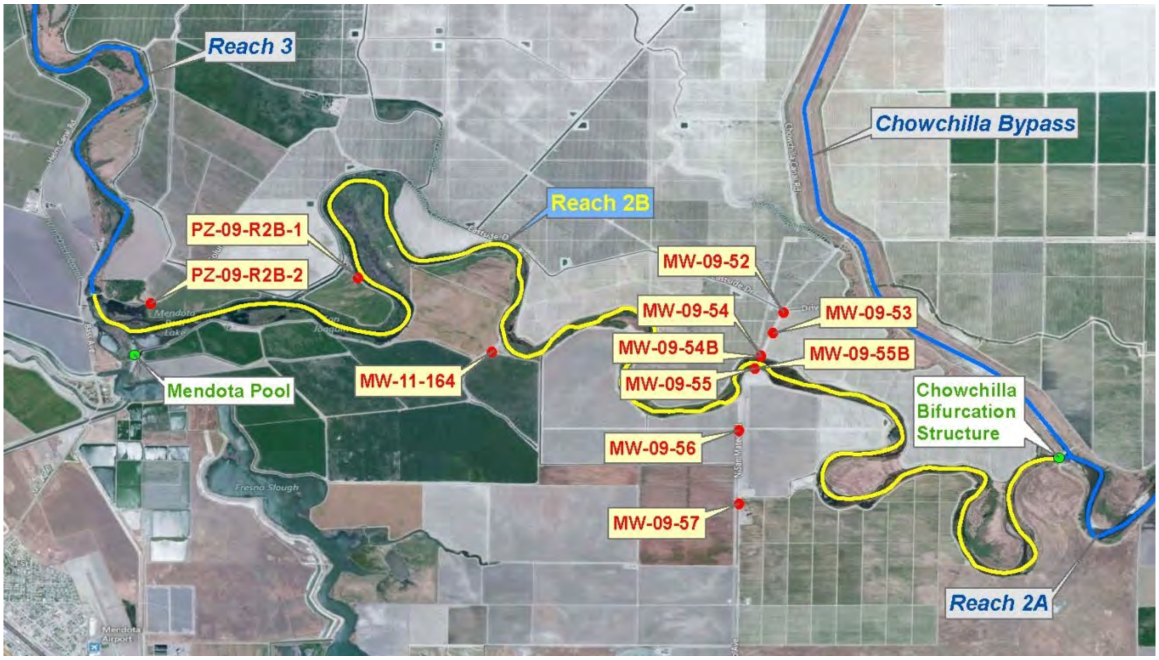
The San Joaquin Valley Groundwater Basin is composed of 16 subbasins: nine of these subbasins are located in the San Joaquin River hydrologic region and seven of these subbasins are located in the Tulare Lake hydrologic region (DWR 2006). The Project area is located within the Delta-Mendota subbasin, which is located within both the San Joaquin River hydrologic region and the Tulare Lake hydrologic region.

Groundwater in the Delta-Mendota subbasin occurs in three water-bearing zones within the Tulare Formation: terrace deposits, alluvium, and flood-basin deposits. The lower section of the Tulare Formation contains confined fresh water. The upper section of the Tulare Formation contains confined, semi-confined, and unconfined water. A shallow zone contains unconfined water approximately 25 feet or less below ground surface. The Corcoran Clay underlies the basin at depths that range from 100 to 500 feet below ground surface and acts as a confining layer.

Land subsidence has occurred in the Delta-Mendota subbasin due to historical groundwater level decline. Total subsidence near Mendota Pool reached nearly 9 feet by 2001, as compared to 1935 levels. Subsidence rates were greatest in the 1950s, with an average rate near Mendota Pool of 4.4 inches per year (in/year) between 1953 and 1957. Subsidence rates near Mendota Pool have been reduced in more recent years, with subsidence rates averaging 0.44 in/year between 1997 and 2001 and 0.04 in/year between 2003 and 2008 (Sneed et al. 2013).

Groundwater Conditions in the Project Area

The Program has collected groundwater data at several locations in the Project area (see Figure 13-6). The majority of these wells monitor shallow groundwater located within the top 20 to 30 feet below ground surface. Station MW-09-54B has real-time data available online at the California Data Exchange Center. At this station, depth to groundwater has ranged from approximately 8 feet to 20 feet below ground surface from February 2010 to July 2013. In Reach 2B, shallower groundwater levels correspond to flood and Interim and Restoration flows, while deeper groundwater corresponds to summer and low flow periods.



Source: SJRRP 2012a

Figure 13-6.
Reach 2B Monitoring Well Atlas

Salt management is one of the most serious long-term groundwater quality issues in the San Joaquin Valley. In this respect, the groundwater in Reach 2B is of relatively high quality. Electrical conductivity, a measure of salinity, at Station MW-09-54B has for the same period ranged from approximately 75 to 325 microsiemens per centimeter (μS/cm). These values are well below the salinity threshold of 1,500 μS/cm established for Reach 2B, as described in the Program's *Seepage Management Plan* (SJRRP 2014). Groundwater quality data for other parameters are limited, as seen in Mathany et al. (2013).

13.2 Regulatory Setting

This section presents applicable Federal, State, and local laws and regulations associated with groundwater resources in the Project area.

13.2.1 Federal

This section presents applicable Federal regulations associated with groundwater resources in the Project area and vicinity.

Clean Water Act

Section 402 of the Clean Water Act created the National Pollutant Discharge Elimination System (NPDES) permit program. This program covers point sources of pollution discharging into a surface water body, including dewatering of shallow groundwater. See Chapter 14.0, "Hydrology – Surface Water Resources and Water Quality," for a discussion of the Clean Water Act.

13.2.2 State of California

This section describes State regulations and policies associated with groundwater resources in the Project area and vicinity.

Porter-Cologne Water Quality Control Act

The Porter-Cologne Water Quality Control Act is California's statutory authority for protecting groundwater quality. See Chapter 14.0, "Hydrology – Surface Water Resources and Water Quality," for a discussion of Porter-Cologne Water Quality Control Act.

Assembly Bill 3030 – Groundwater Management Act

The Groundwater Management Act (Assembly Bill [AB] 3030) is found in sections 10750–10756 of the California Water Code and provides a systematic procedure for an existing local agency to develop a groundwater management plan. AB 3030 gives the local agency the authority to develop a groundwater management plan in groundwater basins defined in DWR Bulletin 118 (DWR 2003) and to raise revenue to pay for facilities to manage the basin (extraction, recharge, conveyance, quality). AB 3030 consists of 12 technical components, but others may be identified in the groundwater management plan. An AB 3030 plan can be developed after a public hearing, and adoption of a resolution of intention to adopt a groundwater management plan. Groundwater management plans have been developed for a number of irrigation districts, counties, cities, and other private districts in the San Joaquin Valley Groundwater Basin, including the San Joaquin River Exchange Contractors Water Authority's *AB 3030 – Groundwater Management Plan* (2008), which covers the Project area.

Other Existing Management Policies

Existing law regarding groundwater is controlled by jurisdictional decisions. The California Water Code provides limited authority over groundwater use by allowing the formation of special districts (or water agencies) through general or special legislation. As reported in the PEIS/R (SJRRP 2011, page 12-50), DWR identifies nine groundwater management agencies formed by such special legislation, none of which are located in the Central Valley area.

Another means of groundwater management exists for surface water agencies that can show that surface water delivered to a given area recharges a local aquifer. Several agencies have used this statutory authority granted by the legislature to levy charges for groundwater extraction. The only agency in the San Joaquin Valley that has exercised this authority is the Rosedale-Rio Bravo Water Storage District in the Tulare Lake hydrologic region, which does not serve the Project area.

13.2.3 Regional and Local

This section provides information about the regional and local regulatory setting, policies, and programs associated with groundwater resources in the Project area and vicinity.

Fresno County General Plan

The Fresno County General Plan Policy Document (Fresno County 2000) outlines several policies for groundwater resources. These policies include the following.

- Policies OS-A.12 through OS-A.17 encourage groundwater recharge, water banking, local groundwater management, and aquifer recharge.
- Policy OSA.25 seeks to protect groundwater resources from contamination and overdraft.
- Policy PF-C.21 provides for new wells that are in close proximity to live streams or water courses.

Madera County General Plan

The Madera County General Plan Policy Document (Madera County 1995) outlines several policies designed to protect groundwater resources. For example, Policies 5.C.1 and 5.C.7 seeks to protect areas of groundwater recharge and to protect groundwater resources from contamination and further overdraft.

13.3 Environmental Consequences and Mitigation Measures

13.3.1 Impact Assessment Methodology

This section describes the impact assessment methodology used to evaluate potential impacts on groundwater resources. The analysis of the Project alternatives is both qualitative and quantitative in nature. Construction-related effects on groundwater were evaluated qualitatively based on review of regional groundwater information and the type of construction activities anticipated. The assessment of areas potentially affected by seepage was quantitative in nature and was based upon a cross-sectional seepage model developed for the Project area by the Program.

The quantitative approach was used to develop estimates of areas vulnerable to seepage and high water table effects associated with potential rises in groundwater levels in the Project area due to the implementation of Project alternatives. The aquifer response to a flow of 4,500 cubic feet per second (cfs) in the San Joaquin River was used to evaluate potential rise in groundwater elevations in the absence of seepage control measures. Results from this modeling represent “worst case” conditions because all Project alternatives would implement seepage control measures as part of the Project design.

The U.S. Geological Survey (USGS) Central Valley Hydrologic Model (CVHM), a valley-wide numerical groundwater flow model (USGS 2009), was used as a starting point for the cross-sectional seepage model. Specifically, CVHM was used as the basis for the development of a series of six, simplified cross-sectional seepage model profiles located at various distances along Reach 2B (Figure 13-7). The CVHM was not directly used because the aerial and vertical grid spacing is too coarse to evaluate groundwater levels immediately adjacent to the river (CVHM was constructed with a lateral grid size of 1 mile by 1 mile and a top layer thickness of 50 feet).

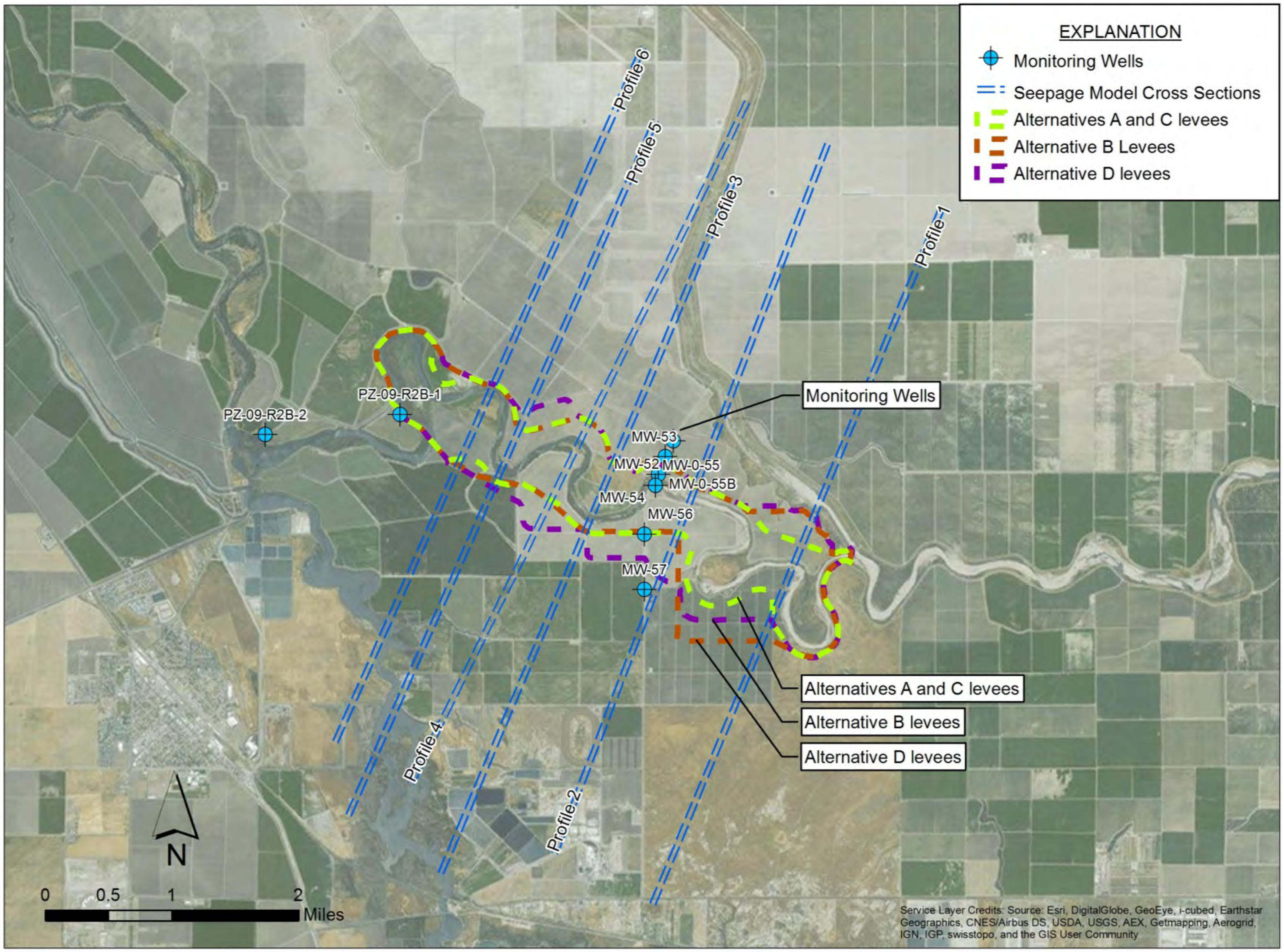


Figure 13-7.
Location of Cross Sectional Seepage Model Cross-Sections

USGS is currently updating CVHM to include the results of a Hydrologic Engineering Center River Analysis System (HEC-RAS) model for the Project area as well as refined grid spacing and layering for the purposes of assessing SJRRP groundwater impacts. The revised CVHM was not available for the Draft Environmental Impact Statement/Report (EIS/R).

Each of the six groundwater model profiles shown in Figure 13-7 is oriented perpendicular to the river channel, and extends approximately 3 miles in each direction away from the river. The profile locations were selected away from river meanders, if possible, in order to minimize numerical errors. Each profile model is composed of six layers, extending from the ground or river surface to the top of the regional confining aquifer unit, the Corcoran Clay. The lateral grid cell size at the river is 10 feet and gradually increases away from the river to a maximum of 400 feet.

The output from the existing HEC-RAS model was used to assign water levels in the river channel at each cross sectional profile. High resolution LiDAR (Light Detection and Ranging) data were incorporated into the model to account for variations in land surface topography. The depths to water simulated by the model[1] were compared with the significance criteria, described below. The distance from the levees at which simulated water level rises exceed the significance criteria were imported into a Geographic Information System (GIS) platform and interpolated spatially along the course of the river to estimate the acreage of land potentially impacted by rising groundwater as a result of Restoration Flows.

13.3.2 Significance Criteria

The thresholds of significance for groundwater impacts are based on the Environmental Checklist Form in Appendix G of the California Environmental Quality Act (CEQA) Guidelines, as amended. These thresholds also encompass factors taken into account under the National Environmental Policy Act (NEPA) to determine the significance of an action in terms of its context and the intensity of its effects. Impacts on groundwater resources would be significant if implementation of an Alternative would cause the following:

- A change in groundwater level resulting in long-term overdraft conditions for the groundwater basins.
- A change in groundwater level adjacent to the San Joaquin River resulting in increased groundwater levels in localized areas already experiencing high groundwater levels.
- A change in groundwater quality resulting in substantially adverse effects to designated beneficial uses of groundwater.

[1] The scenarios simulated by the cross sectional model were based on the initial alternatives evaluation (Project Description Technical Memorandum, Appendix A, SJRRP 2012b). The model scenarios that are comparable to the current alternatives are FP2, which simulates a narrow floodplain, and FP4, which simulates a wide floodplain.

13.3.3 Impacts and Mitigation Measures

This section provides an evaluation of direct and indirect effects of the Project Alternatives on groundwater. It includes analyses of potential effects relative to No-Action conditions in accordance with NEPA and potential impacts compared to existing conditions to meet CEQA requirements. The analysis is organized by Project alternative with specific impact topics numbered sequentially under each alternative. With respect to groundwater, the environmental impact issues and concerns are:

1. Temporary Construction-Related Effects on Groundwater Quality.
2. Long-term Changes in Groundwater Quality.
3. Changes in Groundwater Levels.
4. Changes in Groundwater Recharge.

Other groundwater-related issues covered in the PEIS/R are not covered here because they are programmatic in nature and/or are not relevant to the Project area. Long-term overdraft as a result of Restoration Flows is also not anticipated due to the additional infiltration of river water to the regional aquifer system. Therefore, these issues are not applicable and are not discussed further.

No-Action Alternative

Under the No-Action Alternative, the Project would not be implemented and none of the Project features would be developed in Reach 2B of the San Joaquin River. However, other proposed actions under the SJRRP would be implemented, including habitat restoration in other reaches, augmentation of river flows, and reintroduction of salmon. Without the Project in Reach 2B, however, the proposed actions in other reaches would not achieve the Settlement goals. This section describes the impacts of the No-Action Alternative. The analysis is a comparison to existing conditions.

Impact GRW-1 (No-Action Alternative): ***Temporary Construction-Related Effects on Groundwater Quality.*** Under the No-Action Alternative, the Project would not be implemented and there would be no construction activities in the Project area. As a result, there would be **no impact** to groundwater quality from construction-related effects.

Impact GRW-2 (No-Action Alternative): ***Long-term Changes in Groundwater Quality.*** Under the No-Action Alternative, the quality of shallow groundwater is not anticipated to change substantially. Groundwater quality in the reach is influenced by the quality of the surface water that infiltrates locally. Because Millerton Lake is a source of high quality water with lower salinity than Mendota Pool, infiltration of Restoration Flows would improve the quality of shallow groundwater in the reach. Compared to existing conditions, there would be a **beneficial** effect on groundwater quality over time.

Impact GRW-3 (No-Action Alternative): ***Changes in Groundwater Levels.*** Prior to the start of Interim Flows in October 2009, portions of the Project area historically experienced groundwater seepage to adjacent lands during elevated flood flows. Seepage in Reach 2B has been observed at flows above 1,300 cfs when the Mendota Dam flashboards are in place (RMC 2007). Seepage in Reach 2B caused by high flows can be reduced by removal of the flashboards and by opening the sluice gates at Mendota Dam in advance of high-flow conditions. This process lowers the water level in the pool during high flow events to reduce seepage impacts to adjacent lands.

Under the No-Action Alternative, flows could continue to affect areas outside of the levees that have historically experienced groundwater seepage. Increases in flow duration or frequency could affect adjacent agricultural lands by saturating soil in the rooting zone, impairing plant growth and survival, or interfering with the ability to use machinery to work soil. However, Program-level seepage management measures would be implemented in the Project area that would minimize impacts to areas near the river channel. Consequently, adverse effects to agricultural lands would be minimized. Compared to existing conditions, seepage-related impacts in the Project area would continue under the No-Action Alternative; however, Program-level seepage management measures would be implemented to minimize seepage-related effects. As a result, there would be a **less-than-significant** impact from changes in groundwater levels.

Impact GRW-4 (No-Action Alternative): ***Changes in Groundwater Recharge.*** Under the No-Action Alternative, Restoration Flows would be conveyed through Reach 2B. The No-Action Alternative would maintain the existing levee alignments and heights and maximum conveyance would continue to be limited to the existing channel capacity. Although the area for potential groundwater recharge would not change compared to existing conditions, flow would occur year-round for most water year types (see Figure 1-10) resulting in groundwater recharge in previously dry sections of the river (i.e., the river channel above the San Joaquin River arm of Mendota Pool). As a result, there would be a **beneficial** effect on groundwater recharge in the Project area.

Alternative A (Compact Bypass with Narrow Floodplain and South Canal)

Alternative A would include construction of Project facilities including a Compact Bypass channel, a new levee system encompassing the river channel with a narrow floodplain, and the South Canal. The Reach 2B floodplain would have an average width of approximately 3,000 feet. Other key features include construction of the Mendota Pool Dike (separating the San Joaquin River and Mendota Pool), a fish barrier below Mendota Dam, and the South Canal bifurcation structure with fish passage facility and fish screen, modification of the San Mateo Avenue crossing, and the removal of the San Joaquin River control structure at the Chowchilla Bifurcation Structure. Construction activity is expected to occur intermittently over an approximate 132-month timeframe.

Impact GRW-1 (Alternative A): ***Temporary Construction-Related Effects on Groundwater Quality.*** Construction associated with channel and structural improvements under Alternative A could temporarily influence surface water quality, and could potentially lead to changes in groundwater quality. Compared to the No-Action Alternative, construction activities under Alternative A could discharge waste petroleum products or other construction-related substances that could enter waterways in runoff. In addition, chemicals associated with operating heavy machinery would be used, transported, and stored onsite during construction activities. These substances could be inadvertently introduced into the San Joaquin River through site runoff or onsite spills. Sediment and chemicals could degrade water quality in the San Joaquin River. This would potentially affect groundwater quality through percolation from the soil surface or surface water interaction with underlying groundwater. Furthermore, the Project could potentially impact groundwater quality through discharges of dewatering effluent if groundwater is encountered during construction.

When comparing Alternative A to existing conditions, impacts to groundwater quality from potential discharges of chemicals through site runoff or onsite spills would be similar to those described above (i.e., the comparison of Alternative A to the No-Action Alternative). These impacts to groundwater quality would be **potentially significant**.

Mitigation Measure GRW-1A (Alternative A): ***Prepare and Implement a Stormwater Pollution Prevention Plan.*** This mitigation measure is the same as Mitigation Measure SWQ-1 (Alternative A), as described in Chapter 14.0, "Hydrology – Surface Water Quality." Construction activities are subject to construction-related stormwater permit requirements of the Federal Clean Water Act's NPDES program. A Stormwater Pollution Prevention Plan (SWPPP) will be prepared that identifies best management practices (BMPs) to prevent or minimize the introduction of contaminants into surface waters. The SWPPP will detail the construction-phase housekeeping measures for control of contaminants, as well as the treatment measures and BMPs to be implemented for control of pollutants once the Project has been constructed. The SWPPP will establish good housekeeping measures such as construction vehicle storage and maintenance, handling procedures for hazardous materials, and waste management best management practices. They include procedural and structural measures to prevent release of wastes and materials used at the site. Implementation of the SWPPP would avoid or reduce runoff pollutants at the construction sites to the "maximum extent practicable."

> **Implementation Action**: The Project proponents and/or construction contractor will prepare and implement an SWPPP consistent with requirements in the Statewide NPDES Construction General Permit. The SWPPP will set forth a best management practice monitoring, maintenance, and reporting schedule and will identify the responsible entities during the construction and post-construction phases. Monitoring will include visual inspections of the best management practices, inspection for non-stormwater discharges, and visual inspection and/or sample collection of stormwater discharges. If monitoring results indicate polluted discharges, a construction site and run-on evaluation will be conducted to determine the source of the pollutant and corrective actions will be implemented immediately if necessary.

> **Location**: Project areas with active construction or used by construction personnel, including access roads, staging and storage areas, borrow sites, within the river channel and on adjacent uplands.

> **Effectiveness Criteria**: Performance tracking will be based on successful compliance with the Statewide NPDES Construction General Permit.

> **Responsible Agency**: Reclamation and the construction contractor.

Monitoring/Reporting Action: At a minimum, annual reports will be submitted to the State Water Resources Control Board via the Storm Water Multiple Application and Report Tracking System.

Timing: The SWPPP will be developed prior to construction and will be implemented during construction.

Mitigation Measure GRW-1B (Alternative A): *Prepare and Implement a Construction Groundwater Management Plan.* The Project proponents and/or construction contractor will prepare and implement a Construction Groundwater Management Plan that includes a protocol for sampling and analyzing the quality of dewatering effluent during construction for comparison with existing groundwater. This plan will be consistent with the monitoring and reporting program required by the Statewide NPDES Construction General Permit and/or RWQCB's NPDES Permit for *Dewatering and Other Low Threat Discharges to Surface Waters*, Order No. R5-2013-0074 (General Permit for Low Threat Discharges).[2]

Implementation Action: The Project proponents and/or construction contractor will prepare and implement a Construction Groundwater Management Plan. The plan will include a protocol for sampling and analysis of dewatering effluent during construction and include a description of the sampling methods, locations, and frequency, the constituents monitored, and how the receiving waters will be visually inspected. If monitoring results indicate polluted effluent, a Report of Waste Discharge will be filed with the RWQCB to initiate consultations to obtain a Waste Discharge Order specifying approved treatment methods and disposal options.

Location: Project areas with active dewatering.

Effectiveness Criteria: Performance tracking of this mitigation measure will be based upon successful compliance with the Statewide NPDES Construction General Permit and/or General Permit for Low Threat Discharges.

Responsible Agency: Reclamation and the construction contractor.

Monitoring/Reporting Action: At a minimum, annual reports will be submitted to Reclamation managers summarizing the monitoring data obtained during the previous year(s).

Timing: The Construction Groundwater Management Plan will be developed prior to construction and will be implemented during construction.

Impacts to groundwater quality would be **less than significant** after mitigation.

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[2] The General Permit for Low Threat Discharges covers construction dewatering when the discharges do not contain significant quantities of pollutants and they are either 4 months or less in duration or have a daily average discharge flow that does not exceed 0.25 million gallons per day.

Impact GRW-2 (Alternative A): ***Long-term Changes in Groundwater Quality.*** Compared to the No-Action Alternative, implementation of Alternative A would construct new levees set back from the San Joaquin River, expand the floodplain, and increase the conveyance capacity of the reach. Groundwater in the reach is influenced by soil quality and surface water that infiltrates locally. Conversion of previously irrigated agricultural lands into floodplain areas would reduce new sources of nutrients and pesticides that could influence groundwater quality locally.

Alternative A also includes passive riparian habitat restoration and compatible agricultural practices in the floodplain (e.g., annual crops, pasture, or floodplain-compatible permanent crops). Similar to No-Action conditions, where irrigation of agricultural lands would influence the quality of the shallow aquifer, floodplain inundation of agricultural areas would facilitate movement of nutrients and other materials into the shallow aquifer. However, unlike No-Action conditions, nutrient cycling and pollutant uptake following high flow events on the floodplain would be supported by native aquatic, riparian, and floodplain vegetation.

Compared to existing conditions, surface water quality in Reach 2B would primarily be influenced by San Joaquin River flows (instead of other inflows to Mendota Pool) under Alternative A. Because Millerton Lake is a source of high quality water with lower salinity than Mendota Pool, infiltration of river flows could improve the quality of shallow groundwater in Reach 2B. This would be a **beneficial** effect to long-term groundwater quality.

Impact GRW-3 (Alternative A): ***Changes in Groundwater Levels.*** Restoration Flows could cause changes to groundwater levels in Reach 2B in areas adjacent to the San Joaquin River. Drainage problem areas were defined in the SJVDP (DWR 2005) as locations where the water table is within 5 feet of the ground surface. Potential impacts from the Project have been evaluated in relation to similar thresholds: acres of land outside the proposed levee alignments anticipated to have shallow groundwater elevations above 5 and 7 feet below ground surface. These thresholds represent a range of depths where waterlogging of crops and root-zone salinization may affect adjacent land uses. As described in Section 13.3.1, groundwater levels associated with the conveyance capacity of the reach (4,500 cfs) have been simulated and the acreage of land above these thresholds have been quantified in GIS.

Modeling results indicate the potential presence of shallow groundwater levels above the thresholds of 5 and 7 feet below ground surface along the edges of the San Joaquin River levees in the absence of seepage control measures. Based on the model results, the area outside of the levee alignments with simulated depth to groundwater less than 5 feet is 320 acres and an additional 60 acres is simulated to have depth to groundwater between 5 and 7 feet when river flows are at 4,500 cfs. Figure 13-8 shows the potential areas with depths to groundwater less than monitoring thresholds for the narrow floodplain alternatives, which includes Alternative A. The model shows that infiltration and seepage from the river migrates primarily downward to the water table. The mound of groundwater produced from this infiltration and seepage does not extend more than 1,000 feet laterally from the river.

Under Alternative A, newly constructed levees would be set back from the San Joaquin River such that the Reach 2B floodplain would have an average width of approximately 3,000 feet. Although shallow groundwater could potentially be present and effect adjacent land uses, levee design includes implementation of seepage control measures.

Seepage of river water through or under levees is a concern for levee integrity and adjacent land uses. Through-seepage, water that seeps laterally through the levee section, would be addressed through proper levee design and construction (e.g., selection of low porosity materials and proper compaction). Under-seepage, water that seeps laterally by travelling under the levee section, is primarily controlled by the native soils beneath the levee and seepage control measures would be included where native soils do not provide sufficient control. Seepage control measures would be included, as part of the Project, in in areas where under-seepage is likely to affect adjacent land uses. Seepage control measures could include slurry walls, interceptor drains, seepage wells, seepage berms, land acquisition (fee title or seepage easements) and other measures that can be implemented within the Project area (see Section 2.2.4).

In addition to Project design features, seepage management would be implemented during Project operations. Areas of high groundwater would be identified in accordance with the Program's *Seepage Management Plan* (SJRRP 2014). Once identified, the Program's *Seepage Management Plan* would be implemented to identify measures that would be taken to reduce potential impacts. Through these actions, potential adverse effects of an elevated groundwater level, such as waterlogging of crops and mobilizing of salts in the soil profile, would be further avoided or substantially reduced. Seepage impacts to adjacent lands (outside of the floodplain proposed under Alternative A) are likely to be similar to or less than seepage impacts to adjacent lands (outside of the existing levee alignment) under the No-Action Alternative.

Compared to existing conditions, groundwater levels would likely increase in areas outside of the floodplain proposed under Alternative A, however, seepage impacts would be avoided or substantially reduced by implementation of Project design features and seepage management measures. Therefore, impacts would be **less than significant**.

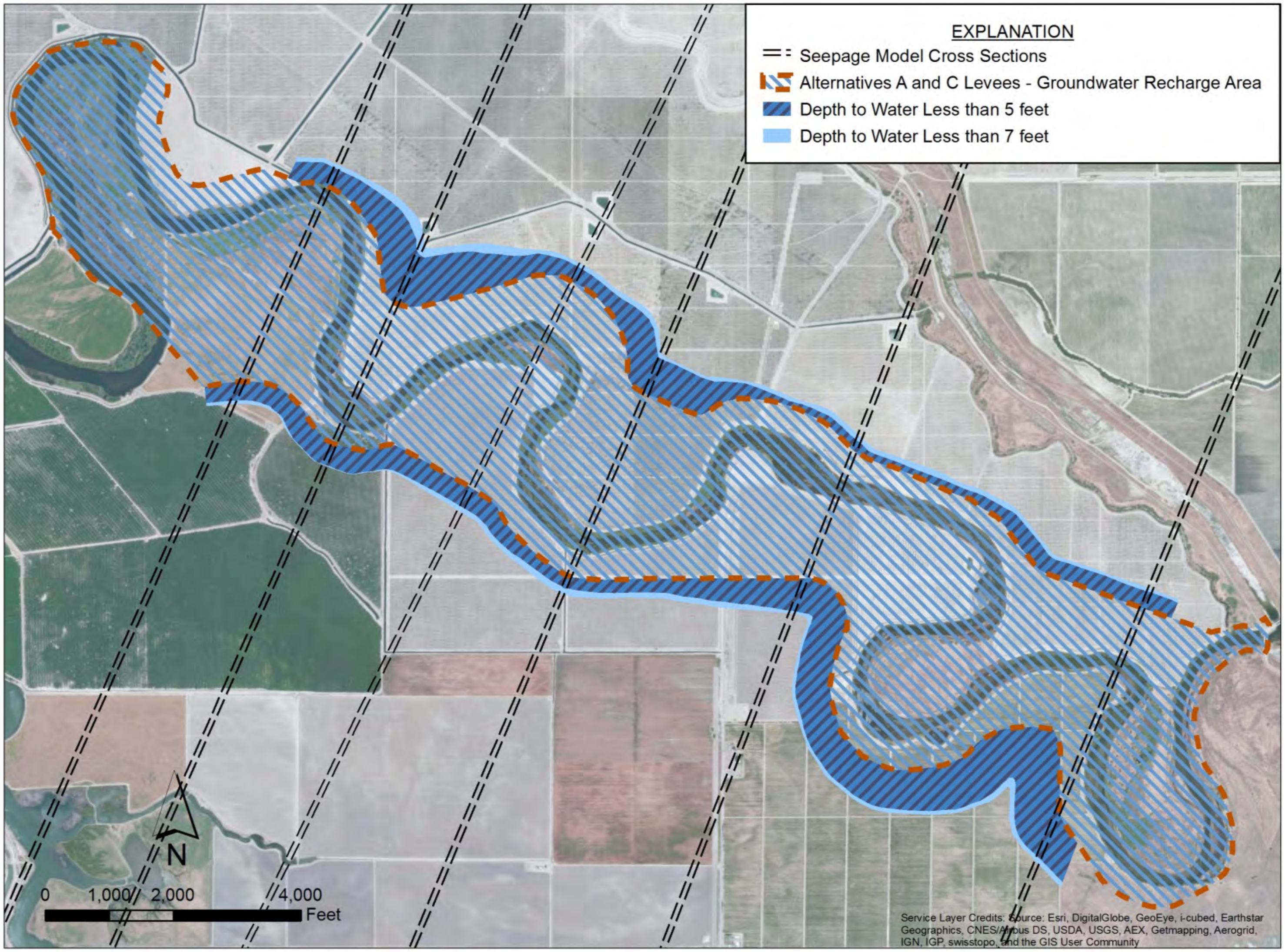


Figure 13-8.
Potential Areas with Depths to Groundwater Less than Monitoring Thresholds – Alternatives A and C

Impact GRW-4 (Alternative A): ***Changes in Groundwater Recharge.*** Compared to the No-Action Alternative, Action Alternatives would construct new levees set back from the San Joaquin River, expand the floodplain, and increase the conveyance capacity of the reach to 4,500 cfs. Under Alternative A the floodplain would have an average width of approximately 3,000 feet. Flow would be conveyed though Reach 2B in the river channel and floodplain providing opportunities for groundwater recharge. Floodplain and channel grading would be used to increase inundation areas during high flow events, remove high areas where flow connectivity would be impeded, and to create floodplain benches adjacent to the river channel to increase the frequency of inundation (see Section 2.2.4). Increasing inundation areas and inundation frequencies would facilitate groundwater recharge in the reach.

Compared to existing conditions, flow would also occur year-round for most water year types (see Figure 1-10) resulting in groundwater recharge in previously dry sections of the river (i.e., in the river channel above the San Joaquin River arm of Mendota Pool). As a result, there would be a **beneficial** effect on groundwater recharge in the Project area.

Alternative B (Compact Bypass with Consensus-Based Floodplain and Bifurcation Structure), the Preferred Alternative

Alternative B would include construction of Project features including a Compact Bypass channel, a new levee system with a wide, consensus-based floodplain encompassing the river channel, and the Compact Bypass Bifurcation Structure with fish passage facility and fish screen. Other key features include construction of a fish passage facility at the San Joaquin River control structure at the Chowchilla Bifurcation Structure, the re-route of Drive 10 ½ (across the Compact Bypass control structure), and removal of San Mateo Avenue crossing. Construction activity is expected to occur intermittently over an approximate 157-month timeframe. The Reach 2B floodplain would have an average width of approximately 4,200 feet.

Impact GRW-1 (Alternative B): ***Temporary Construction-Related Effects on Groundwater Quality.*** Construction associated with channel and structural improvements under Alternative B could temporary influence water quality, and could potentially lead to changes in groundwater quality. Refer to Impact GRW-1 (Alternative A). Potential impacts of Alternative B would be the same as potential impacts of Alternative A. These impacts would be **potentially significant**.

Mitigation Measures GRW-1A and GRW-1B (Alternative B): ***Prepare and Implement a Stormwater Pollution Prevention Plan, Prepare and Implement a Construction Groundwater Management Plan.*** Refer to Mitigation Measures GRW-1A and GRW-1B (Alternative A). The same measures would be used here. Impacts would be **less than significant** after mitigation.

Impact GRW-2 (Alternative B): ***Long-term Changes in Groundwater Quality.*** Refer to Impact GRW-2 (Alternative A). Potential effects of Alternative B would be the same as potential effects of Alternative A. Conversion of previously irrigated agricultural lands into floodplain areas would reduce new sources of nutrients and pesticides that could influence groundwater quality locally. These effects would be **beneficial**.

Impact GRW-3 (Alternative B): ***Changes in Groundwater Levels.*** Modeling results indicate the potential presence of shallow groundwater levels above the thresholds of 5- and 7-feet below ground surface along the edges of the San Joaquin River. Based on the model results, the area outside of the levee alignments with simulated depth to water less than 5 feet is 360 acres and an additional 80 acres have simulated depth of 5 to 7 feet below ground surface. Figure 13-9 shows the potential areas with depths to groundwater less than monitoring thresholds for the wide floodplain alternatives, including Alternative B. Similar to Alternative A, the model shows that infiltration and seepage from the river migrates primarily downward to the water table. The mound of groundwater produced from this infiltration and seepage does not extend more than 1,000 feet laterally from the river.

Through levee design features and seepage management measures, as described in Impact GRW-2 (Alternative A), potential adverse effects of an elevated groundwater level, such as waterlogging of crops and mobilizing of salts in the soil profile, would be avoided or substantially reduced in Alternative B. Compared to the No-Action Alternative, seepage impacts to adjacent lands under Alternative B are likely to be similar to or less than seepage impacts to adjacent lands under the No-Action Alternative.

Compared to existing conditions, groundwater levels would likely increase in areas immediately adjacent to San Joaquin River levees, however, seepage impacts would be avoided or substantially reduced by implementation of Project design features and seepage management measures. Therefore, these impacts would be **less than significant**.

Impact GRW-4 (Alternative B): ***Changes in Groundwater Recharge.*** Refer to Impact GRW-4 (Alternative A). Potential effects of Alternative B would be similar to potential effects of Alternative A, with the exception that the floodplain would have an average width of approximately 4,200 feet. Increasing inundation areas and inundation frequencies would facilitate groundwater infiltration causing a **beneficial** effect on groundwater recharge.

Alternative C (Fresno Slough Dam with Narrow Floodplain and Short Canal)

Alternative C would include construction of Project features including Fresno Slough Dam, a new levee system with a narrow floodplain encompassing the river channel, and the Short Canal. Other key features include construction of the Mendota Dam fish passage facility, the Fresno Slough fish barrier, the Short Canal control structure and fish screen, the Chowchilla Bifurcation Structure fish passage facility, modification of San Mateo Avenue crossing, and Main Canal and Helm Ditch relocations. Construction activity is expected to occur intermittently over an approximate 133-month timeframe. The Reach 2B floodplain would have an average width of approximately 3,000 feet.

Impact GRW-1 (Alternative C): ***Temporary Construction-Related Effects on Groundwater Quality.*** Construction associated with channel and structural improvements under Alternative C could temporary influence water quality, and could potentially lead to changes in groundwater quality. Refer to GRW-1 (Alternative A). Potential impacts of Alternative C would be the same as potential impacts of Alternative A. These impacts would be **potentially significant**.

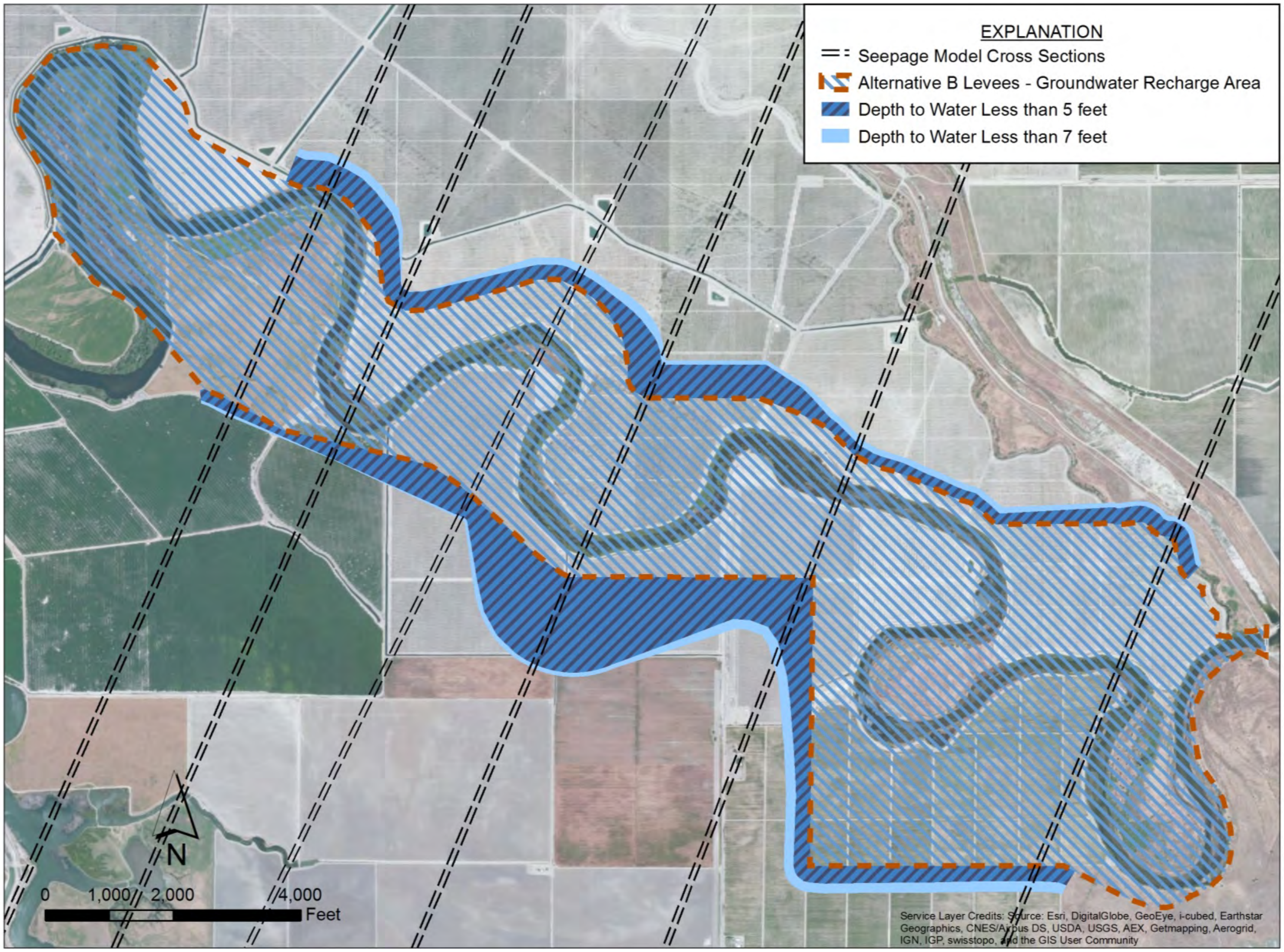


Figure 13-9.
Potential Areas with Depths to Groundwater Less than Monitoring Thresholds – Alternative B

Mitigation Measures GRW-1A and GRW-1B (Alternative C): ***Prepare and Implement a Stormwater Pollution Prevention Plan, Prepare and Implement a Construction Groundwater Management Plan.*** Refer to Mitigation Measures GRW-1A and GRW-1B (Alternative A). The same measures would be used here. Impacts would be **less than significant** after mitigation.

Impact GRW-2 (Alternative C): ***Long-term Changes in Groundwater Quality.*** Refer to Impact GRW-2 (Alternative A). Potential effects of Alternative C would be the same as potential effects of Alternative A, with the exception that agricultural practices would not occur on the floodplain. Conversion of previously irrigated agricultural lands into floodplain areas would reduce new sources of nutrients and pesticides that could influence groundwater quality locally. These effects would be **beneficial**.

Impact GRW-3 (Alternative C): ***Changes in Groundwater Levels.*** Refer to Impact GRW-3 (Alternative A). The impacts to groundwater levels for Alternative C would be the same as for Alternative A because both alternatives involve a narrow floodplain. These impacts would be **less than significant**.

Impact GRW-4 (Alternative C): ***Changes in Groundwater Recharge.*** Refer to Impact GRW-4 (Alternative A). Potential effects of Alternative C would be the same as potential effects of Alternative A. Increasing inundation areas and inundation frequencies would facilitate groundwater infiltration causing a **beneficial** effect on groundwater recharge.

Alternative D (Fresno Slough Dam with Wide Floodplain and North Canal)

Alternative D would include construction of Project features including Fresno Slough Dam, a new levee system with a wide floodplain encompassing the river channel, and the North Canal. Other key features include construction of the Mendota Dam fish passage facility, the Fresno Slough fish barrier, the North Canal bifurcation structure with fish passage facility and fish screen, removal of the San Joaquin River control structure at the Chowchilla Bifurcation Structure, removal of San Mateo Avenue crossing, and Main Canal and Helm Ditch relocations. Construction activity is expected to occur intermittently over an approximate 158-month timeframe. The Reach 2B floodplain would have an average width of approximately 4,200 feet.

Impact GRW-1 (Alternative D): ***Temporary Construction-Related Effects on Groundwater Quality.*** Construction associated with channel and structural improvements under Alternative D could temporary influence water quality, and could potentially lead to changes in groundwater quality. Refer to Impact GRW-1 (Alternative A). Potential impacts of Alternative D would be the same as potential impacts of Alternative A. These impacts would be **potentially significant**.

Mitigation Measures GRW-1A and GRW-1B (Alternative D): ***Prepare and Implement a Stormwater Pollution Prevention Plan, Prepare and Implement a Construction Groundwater Management Plan.*** Refer to Mitigation Measures GRW-1A and GRW-1B (Alternative A). The same measures would be used here. Impacts would be **less than significant** after mitigation.

Impact GRW-2 (Alternative D): *Long-term Changes in Groundwater Quality.* Refer to Impact GRW-2 (Alternative A). Potential effects of Alternative D would be the same as potential effects of Alternative A. Conversion of previously irrigated agricultural lands into floodplain areas would reduce new sources of nutrients and pesticides that could influence groundwater quality locally. These effects would be **beneficial**.

Impact GRW-3 (Alternative D): *Changes in Groundwater Levels.* Modeling results indicate the potential presence of shallow groundwater levels above the thresholds of 5- and 7-feet below ground surface along the edges of the San Joaquin River. Based on the model results, the area outside of the levee alignments with simulated depth to water less than 5 feet is 330 acres and an additional 70 acres have simulated depth of 5 to 7 feet below ground surface. Figure 13-10 shows the potential areas with depths to groundwater less than monitoring thresholds for the wide floodplain alternatives, including Alternative D. Similar to Alternative A, the model shows that infiltration and seepage from the river migrates primarily downward to the water table. The mound of groundwater produced from this infiltration and seepage does not extend more than 1,000 feet laterally from the river.

Through levee design features and seepage management measures, as described in Impact GRW-2 (Alternative A), potential adverse effects of an elevated groundwater level, such as waterlogging of crops and mobilizing of salts in the soil profile, would be avoided or substantially reduced in Alternative D. Compared to the No-Action Alternative, seepage impacts to adjacent lands under Alternative D are likely to be similar to or less than seepage impacts to adjacent lands under the No-Action Alternative.

Compared to existing conditions, groundwater levels would likely increase in areas immediately adjacent to San Joaquin River levees, however, seepage impacts would be avoided or substantially reduced by implementation of Project design features and seepage management measures. Therefore, these impacts would be **less than significant**.

Impact GRW-4 (Alternative D): *Changes in Groundwater Recharge*. Refer to Impact GRW-4 (Alternative A). Potential effects of Alternative D would be similar to potential effects of Alternative A, with the exception that the floodplain would have an average width of approximately 4,200 feet. Increasing inundation areas and inundation frequencies would facilitate groundwater infiltration causing a beneficial effect on groundwater recharge.

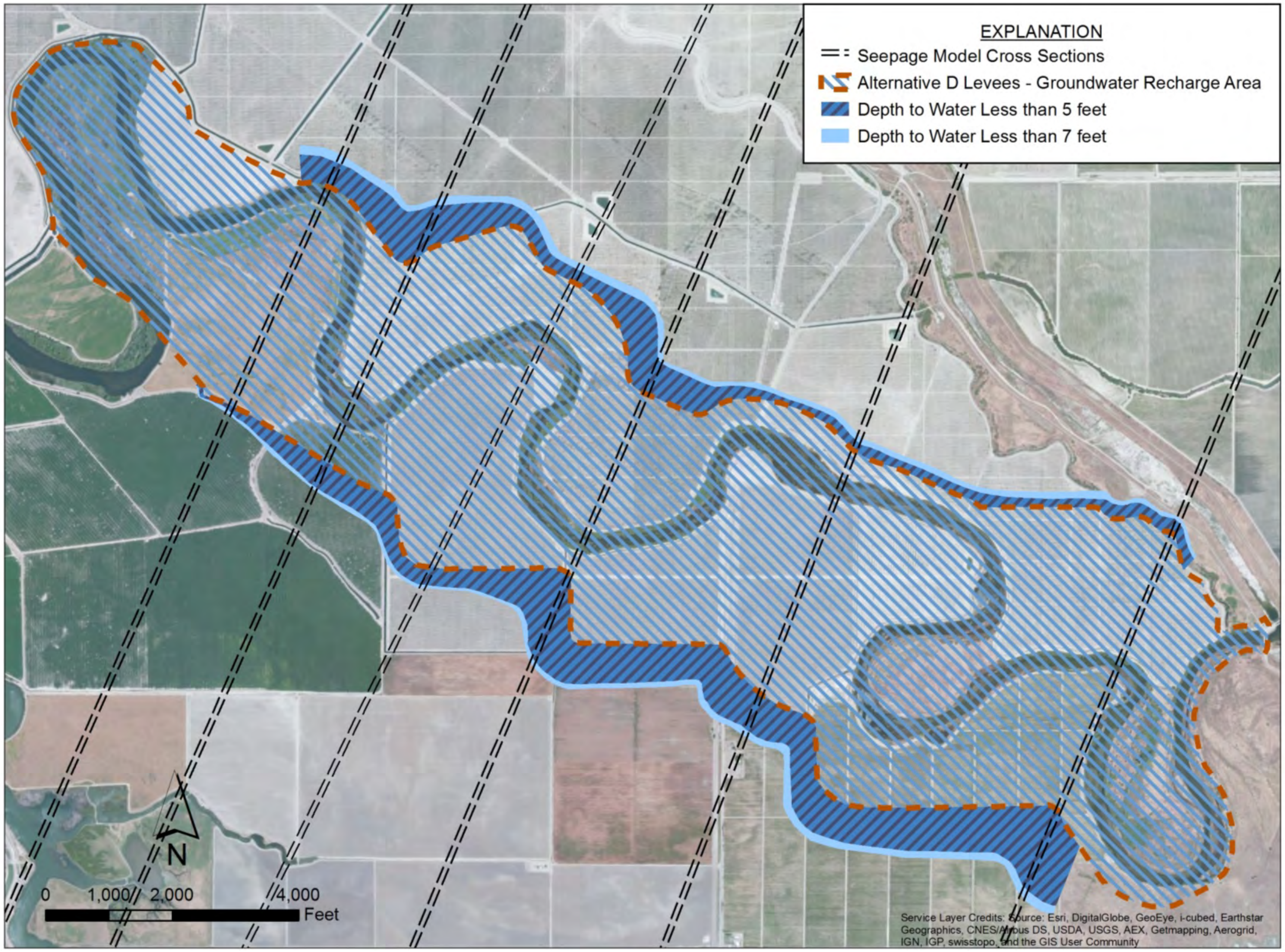


Figure 13-10.
Potential Areas with Depths to Groundwater Less than Monitoring Thresholds – Alternative D

14.0 Hydrology - Surface Water Resources and Water Quality

This section describes the potential impacts that implementation of Project alternatives may have on surface water resources and water quality at the Project area, and explains the environmental setting, applicable regulatory framework, and appropriate mitigation measures.

14.1 Environmental Setting

14.1.1 Physical Conditions

Reach 2B of the San Joaquin River is the 11.2-mile reach between the Chowchilla Bifurcation Structure (river mile [RM] 216) and Mendota Dam (RM 204.8). The Project footprint also includes areas outside of the immediate riparian corridor of Reach 2B that may be affected directly or indirectly by implementing Project alternatives. These areas include the existing levee-confined channel and overbank areas, areas below Mendota Dam, the Compact Bypass area and its discharge point at Reach 3, Fresno Slough, proposed canal alignments that would convey flows from an upstream point along Reach 2B to Fresno Slough, and potential upland borrow areas.

Areas outside of the current levee-contained channel, Mendota Pool, and Fresno Slough are primarily in agricultural production (e.g., alfalfa/field crops, winter vegetables, vineyards, orchards, livestock, etc.) with associated irrigation ditches, and public and private access roads.

Climate

The climate within the Project area and vicinity is semi-arid, with long, hot, dry summers and relatively mild winters. Winter temperatures on the San Joaquin valley floor are usually mild, but drop below freezing during occasional cold spells. Frost occurs in most fall/winter seasons, typically between late November and early March. Monthly average temperature based on long-term records for several weather stations are presented in Table 14-1. Based on these long-term records, the monthly average of the minimum daily temperature ranges from 36 to 66 degrees Fahrenheit (°F), and the monthly average of the maximum daily temperature ranges from 54 to 100°F.

Based on long-term records of precipitation, the average annual precipitation in the Project area is approximately 8.0 inches but increases moving easterly towards the mountains as the elevation increases (Table 14-2). Approximately 90 percent of precipitation in the Project area occurs from November through April. Heavy rainfall and snow in the western Sierra Nevada are the major sources of water in the San Joaquin River Basin. 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 snow that remains after winter serves as stored water before it melts in the spring and summer.

Table 14-1.
Temperature Summary

Station and Metric	Temperature (°F)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Friant Dam (1912-2010)													
Average Max.	55.3	61.3	66.4	73.9	84.1	93	100.4	98.7	92.5	81.2	66.6	56.4	77.5
Average Min.	36.7	39.7	41.2	43.5	49.4	55.4	61	59.4	55.8	49.3	41.6	36.7	47.5
Madera, CA (1928-2010)													
Average Max.	53.9	61.2	67.2	74.8	83.9	91.7	98.2	96.4	90.9	80.3	66.1	55.1	76.7
Average Min.	35.9	39.1	41.7	45.4	51.4	56.7	61.4	59.8	55.2	47.7	39.6	35.7	47.5
Fresno, CA (1948-2010)													
Average Max.	54.5	61.5	67	74.5	83.5	91.7	98.3	96.3	90.6	79.7	65.3	54.7	76.5
Average Min.	37.6	40.7	43.8	47.9	54.3	60.5	65.7	63.9	59.5	51.1	42.4	37.3	50.4

Source: Western Region Climate Center 2011, Stations Friant Government Camp, California (043261), Madera, California (045233), Fresno WSO AP, California (043257)

Table 14-2.
Average Monthly Precipitation

Station	Precipitation (inches)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Friant Dam	2.76	2.60	2.23	1.28	0.46	0.13	0.01	0.01	0.20	0.80	1.48	2.34	14.31
Madera, CA	2.01	1.94	1.78	1.09	0.40	0.09	0.01	0.02	0.14	0.58	1.18	1.80	11.05
Fresno, CA	2.11	1.92	1.85	1.03	0.36	0.14	0.01	0.01	0.16	0.52	1.13	1.66	10.90
Mendota Dam	1.47	1.26	1.29	0.88	0.27	0.04	0.01	0.01	0.21	0.35	0.98	1.21	7.98

Source: Western Region Climate Center 2011

Notes:

Friant Government Camp, California (043261), Period of record: 1912-2010, Elevation: 350 feet

Madera, California (045233), Period of record: 1928-2010, Elevation: 275 feet.

Fresno WSO AP, California (043257), Period of record: 1948-2010, Elevation: 335 feet.

Mendota Dam, California (045528), Period of record: 1948-1984, Elevation: 163 feet.

14.1.2 Surface Water Resources

Reach 2B is located on the San Joaquin River between the Chowchilla Bifurcation Structure and Mendota Dam (see Figure 1-2). Major river systems that can contribute to flow to Reach 2B include the San Joaquin River and Kings River systems (Figure 14-1).

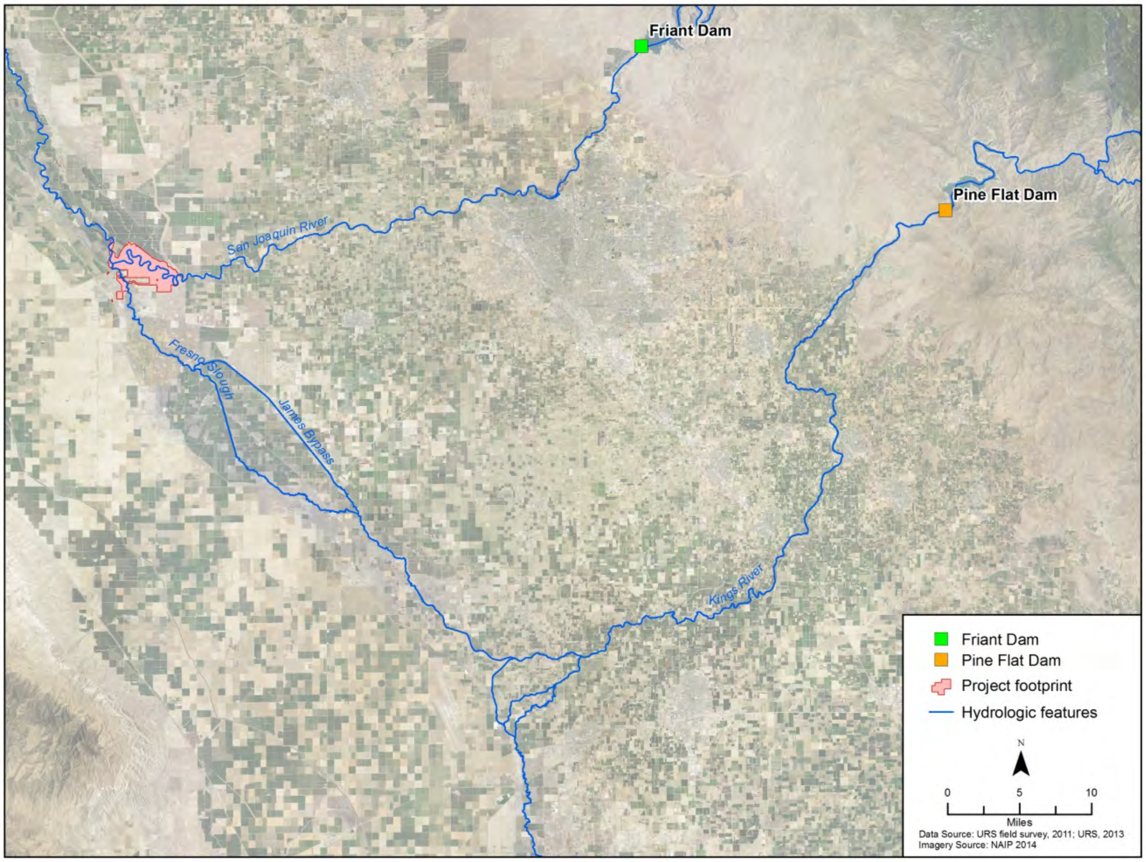


Figure 14-1.
Major River Systems Upstream of Reach 2B

San Joaquin River

The San Joaquin River flows generally northwest through the Central Valley before discharging into the Sacramento-San Joaquin Delta. Reach 2B is a segment of the San Joaquin River. This reach has a sandbed channel confined by earthen levees with an original design conveyance capacity of 2,500 cubic feet per second (cfs).

Flows in Reach 2B are almost entirely regulated by releases from Friant Dam. Friant Dam forms Millerton Lake and is located 51.6 miles upstream of Reach 2B at RM 267.6. Constructed in 1948 with a storage capacity of 520.5 thousand acre-feet (TAF), Millerton Lake provides irrigation water to agricultural users in Fresno, Madera, Kern and Tulare Counties through the Friant-Kern and Madera Canals (San Joaquin River Restoration Program [SJRRP] 2008). Releases from Millerton Lake to the San Joaquin River have typically ranged from 180 to 250 cfs during the May to October irrigation season and from 40 to 100 cfs during the winter (SJRRP 2009). Additional releases occur when the

170 TAF flood storage capacity of Millerton Lake is exceeded. The greatest risk of flooding occurs during warm rain-on-snow events in winter months or at the peak of the spring snowmelt. Prior to implementation of the Interim Flows program on October 1, 2009, flows up to 5,500 cfs were typically diverted to the Chowchilla Bypass at the Chowchilla Bifurcation Structure located at the upstream end of Reach 2B, although the operating rules allow discretion in passing first flows to the downstream river rather than into the Chowchilla Bypass. Flood flows reached the Mendota Pool at the lower end of Reach 2B in 1997, 2001, 2005, 2006, 2007, and 2011 (SJRRP 2009). Table 14-3 lists average, minimum, and maximum flow rates for several gaging stations in the Project area and vicinity. Figure 14-2 indicates the location of these gages.

Table 14-3.
Flow Averages and Ranges at Flow Stations in the Project Vicinity

Station (Station ID)	Period prior to Interim Flows			WY 2010 and 2011[a]	
	Average Flow (cfs)	Range of Flow (cfs)	Period	Average Flow (cfs)	Range of Flow (cfs)
San Joaquin River below Friant (SJF)	629	11 – 36,800	1911 – 2011	1212	31 – 7,794
San Joaquin River at Gravelly Ford (GRF)	441	0 – 10,283	1997 – 2009	1,093	0 – 7,407
Chowchilla Bypass (CBP)	366	0 – 7,341	1997 – 2009	665	0 – 8,348
San Joaquin River below Bifurcation (SJB)	167	0 – 2,434	1990 – 2002, 2005 – 2009	308	0 – 1,415
San Joaquin River at San Mateo Road Crossing Near Mendota (SJN)	NA	NA	NA	501[b]	121 – 1,425
San Joaquin River near Mendota, CA (MEN)	496	0 - 5,906	1993 – 2009	621	0 – 3,570
James Bypass Near San Joaquin, CA (JBP)	343	0 - 5,360	1976 – 2009	1,138	0 – 4,441

Source: SJRRP 2011a, DWR 2011, USGS 2011

Notes:

[a] Includes both Interim Flows and flood flows.

[b] The period of record is from February 2010 to September 2011.

Key:

cfs = cubic feet per second

WY = water year

Prior to the Interim Flows program, the upper half of Reach 2B above the San Mateo Avenue crossing at RM 211.8 was generally dry and flow would reach Mendota Pool from Reach 2B only during periods of flood management releases. The lower half of Reach 2B (RM 204.8 to 211.8) is backwatered by Mendota Dam. With the exception of Fresno Slough which discharges flood flows from the Kings River system to Mendota Pool, there are no natural tributaries in Reach 2B. Agricultural return flows within the reach are reportedly minor (SJRRP 2009).

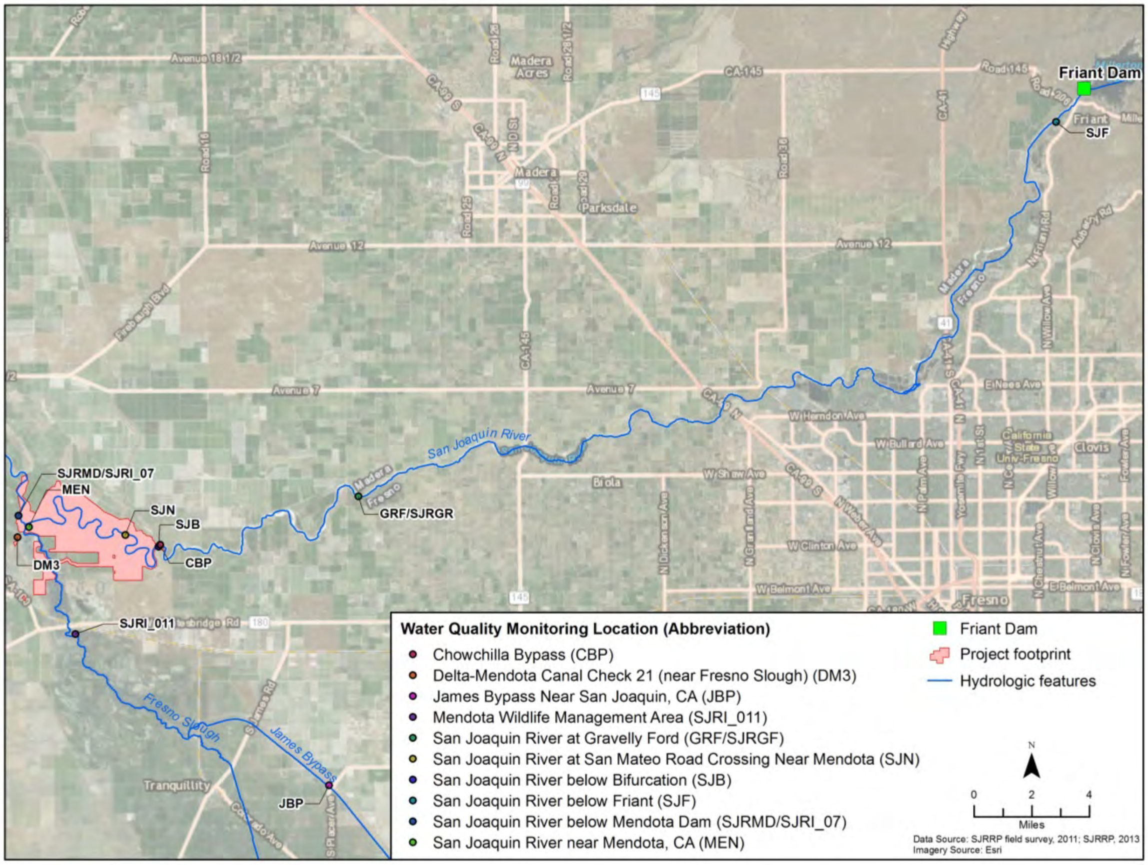


Figure 14-2.
Monitoring Locations

Seepage of river flows to shallow groundwater is generally considered detrimental to agricultural lands due to the potential for waterlogging crops, root-zone salinization, and levee instability (SJRRP 2011c). Seepage in Reach 2B has been observed at flows above 1,300 cfs when the Mendota Dam flashboards are in place (San Joaquin River Resources Management Coalition 2007). Seepage in Reach 2B caused by high flows can be reduced by removal of the flashboards and by opening the sluice gates at Mendota Dam. These sluice gates and flashboards can be manually opened or removed in advance of high-flow conditions. This process lowers the water level in the pool during high flow events to reduce seepage impacts to adjacent lands, but hinders distribution of flows into the irrigation canals. Additional information on the seepage issue and interaction between surface and groundwater is provided in Chapter 13.0, “Hydrology-Groundwater.”

Chowchilla Bypass

The Chowchilla Bypass extends from the Chowchilla Bifurcation Structure to the Eastside Bypass at the confluence of Fresno River. The design channel capacity of the bypass near the San Joaquin River is 5,500 cfs. The bypass is an unlined channel constructed in highly permeable soils, and much of the initial flood flows infiltrate and recharge groundwater (U.S. Department of the Interior, Bureau of Reclamation [Reclamation] and California Department of Water Resources [DWR] 2005).

Mendota Pool

Mendota Dam was constructed in 1917 at RM 204.8. Mendota Pool is the reservoir created by Mendota Dam and has both a San Joaquin River arm and a Fresno Slough arm. The San Joaquin arm of Mendota Pool extends to the San Mateo Avenue crossing. The Fresno Slough arm of Mendota Pool extends several miles south of the Project area. The pool serves as a distribution point for irrigation water supplies delivered by the Delta-Mendota Canal (DMC) and for refuge water supply to the Mendota Wildlife Area. It has a capacity of 8 TAF, a surface area of approximately 2,000 acres when full, and varies in width from less than 100 to several hundred feet (SJRRP 2011d). During the summer irrigation season, the water-surface elevation in the pool is maintained at a depth of approximately 18 feet in the immediate vicinity of the dam, and water elevations generally fluctuate less than 6 inches. Upstream channel depths are typically only about 4 feet, generally decreasing in the upstream direction.

Mendota Pool provides no long-term storage for water supply operations or flood management. Mendota Pool is primarily filled by the DMC, which has a design capacity of 4,600 cfs but typically conveys 2,500 to 3,000 cfs from the Sacramento-San Joaquin Delta during the irrigation season. When the DMC is not in operation, flow at Mendota Dam can fall to zero. Mendota Pool is not intended for flood control; flashboards on the dam are removed prior to high-flow events. During spring flood events, average monthly flow at Mendota Dam can reach 2,600 cfs.

Mendota Pool delivers water to the San Joaquin River Exchange Contractors Water Authority, other Central Valley Project contractors, wildlife refuges and management areas, and State water contractors. Water delivered to Mendota Pool from the DMC is withdrawn at seven canal or pump locations in the pool, leaving about 500 cfs to be discharged down the San Joaquin River for delivery to the Arroyo Canal, which is located about 23 miles downstream from Mendota Dam (SJRRP 2011b, pages 11-9 and 13-22).

Fresno Slough/James Bypass

Fresno Slough is a distributary of the North Fork of the Kings River and is an intermittent stream that flows northwesterly to the Project area. James Bypass is a constructed channel that bypasses a portion of Fresno Slough. Flows in the North Fork of the Kings River consist primarily of flood releases from Pine Flat Dam located about 55 miles to the east. Under current operational requirements, Kings River flood flows can enter Mendota Pool via Fresno Slough/James Bypass. Flows from the Kings River are regulated by Pine Flat Dam releases and the Crescent Weir, which are operated by the Kings River Conservation District. Pine Flat Dam has routed surplus flows through Fresno Slough/James Bypass in 20 of 53 years of operation (U.S. Environmental Protection Agency [EPA] 2007). Reclamation supplements natural flow from Fresno Slough/James Bypass and San Joaquin River into Mendota Pool with deliveries from the DMC to satisfy water supply contracts.

Interim Flows Program

The Interim Flows program began at the start of water year[1] 2010 and involves the release of 350 to 1,660 cfs from Friant Dam with a maximum flow of 1,300 cfs at the upstream end of Reach 2B in spring. These experimental flows have provided valuable information regarding temperatures, fish needs, seepage losses, shallow groundwater conditions, recirculation, recapture and reuse conditions, channel capacity, and levee stability. Restoration Flows were released starting on January 1, 2014. Restoration Flows are limited to the existing conveyance capacity of the reach.

Water Rights

Reclamation holds most of the water rights on the San Joaquin River, allowing diversion of water at Friant Dam pursuant to water rights permits and license. In order to facilitate exercise of these rights, purchase and exchange agreements have been executed involving water rights existing at the time the Central Valley Project was developed. The Exchange Contract provides for an annual delivery of approximately 850 TAF of water, subject to shortage provisions, to water right holders along the San Joaquin River in exchange for not exercising rights to divert from the San Joaquin River. This exchange is met with Delta deliveries from the DMC. If sufficient water from the DMC were not available for the exchange, Reclamation would need to make flows available from the San Joaquin River. With the exception of flood flows and releases made in compliance with Public Law 111-11, water passing Friant Dam is limited to that necessary to maintain the 5 cfs flow requirement at Gravelly Ford pursuant to various Holding Contracts.

14.1.3 Geomorphology

The San Joaquin River in Reach 2B is characterized by a single-thread, meandering, sand-bed channel that is bounded by local levees and a relatively flat overbank surface (Figure 14-3). The approximately 11.2-mile reach has a sinuosity[2] of about 2.2, the highest of any portion of the overall Restoration Area (Figure 14-4). The high sinuosity results from a combination of natural and man-induced factors. Geologically driven subsidence of the San Joaquin Valley, primarily downstream from Mendota Dam, is ongoing at a rate of about 0.25 millimeters (0.01 inch) per year (Ouchi 1983), and this rate accelerated significantly beginning in the 1920s due to human-induced subsidence associated with groundwater withdrawal and hydrocompaction of the soils by irrigation (Poland et al. 1975, Bull 1964, Sneed et al. 2013). (Subsidence is discussed further in Chapter 11.0, “Geology and Soils” and Chapter 13.0, “Hydrology – Groundwater.”) The general alignment of the river down the dip slope of the subsiding basin causes the valley floor in Reach 2B to be steeper than in the up- and downstream reaches (Figure 14-5). The high sinuosity represents the historic adjustment of the river slope to achieve sediment-transport balance with the upstream sediment supply through lengthening of the channel.

[1] Most hydrologic monitoring occurs for a period defined as a water year, which begins on October 1 and ends on September 30 of the named year. For example, water year 2010 began on October 1, 2009 and concluded on September 30, 2010.

[2] Sinuosity is defined as the ratio of length along the river to the approximate straight-line distance down the valley.

Comparison of the river maps prepared by the California Debris Commission in 1914 with current aerial photography and mapping indicates that there has been very little change in the channel alignment since at least the early 20th century (Figure 14-3 [bottom]), even though the river continued to see relatively high flows on a regular basis until completion of Friant Dam in the 1940s (Figure 14-6). Although the scale and resolution do not permit direct comparison with the current river alignment, mapping from the mid-1800s by the General Land Office and the 1880s by William Hammond Hall indicate that this reach had a meandering planform similar to the existing planform even at that time.

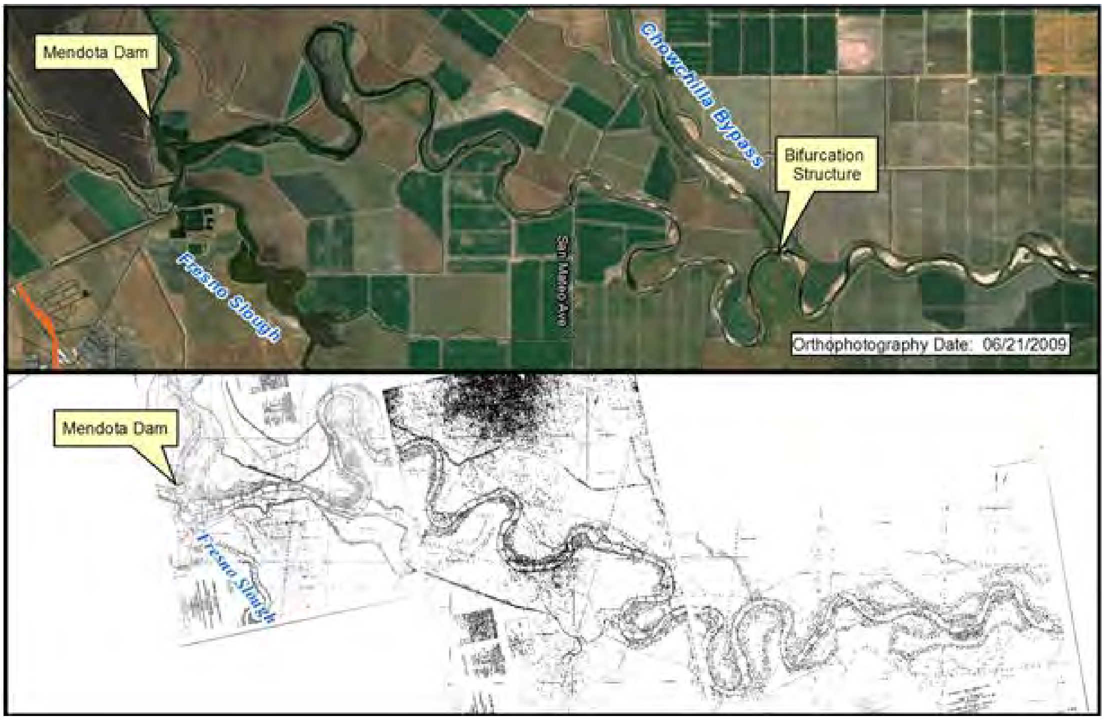


Figure 14-3.
Aerial Photograph from 2009 (Top) and California Debris Commission Mapping from 1914 (Bottom) of Reach 2B

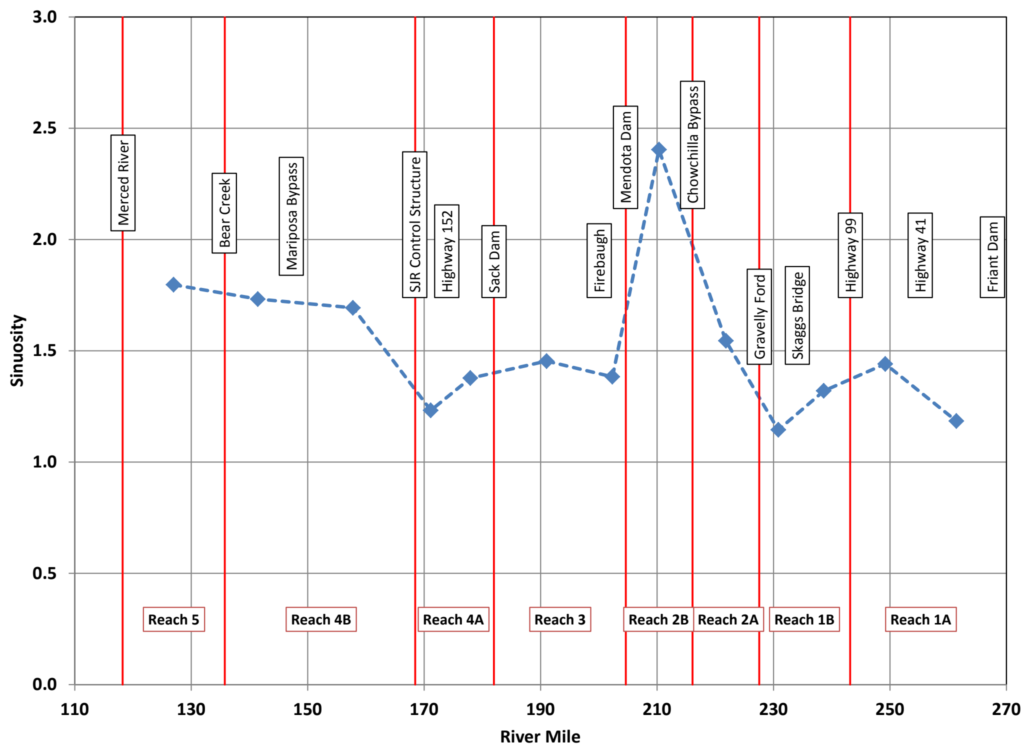


Figure 14-4.
Sinuosity of the San Joaquin River between Friant Dam and the Merced River

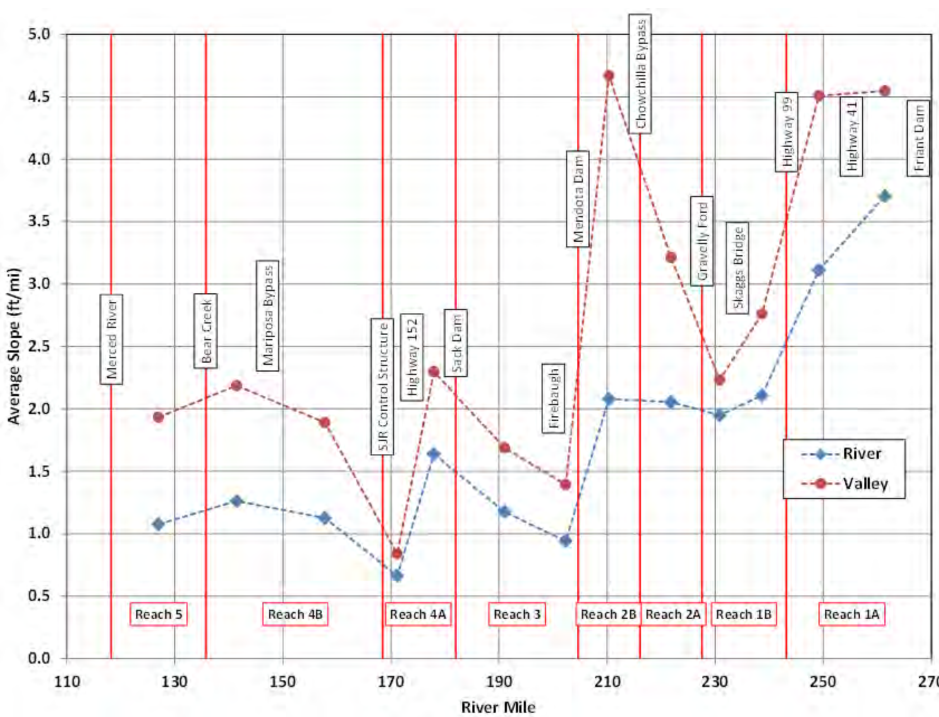
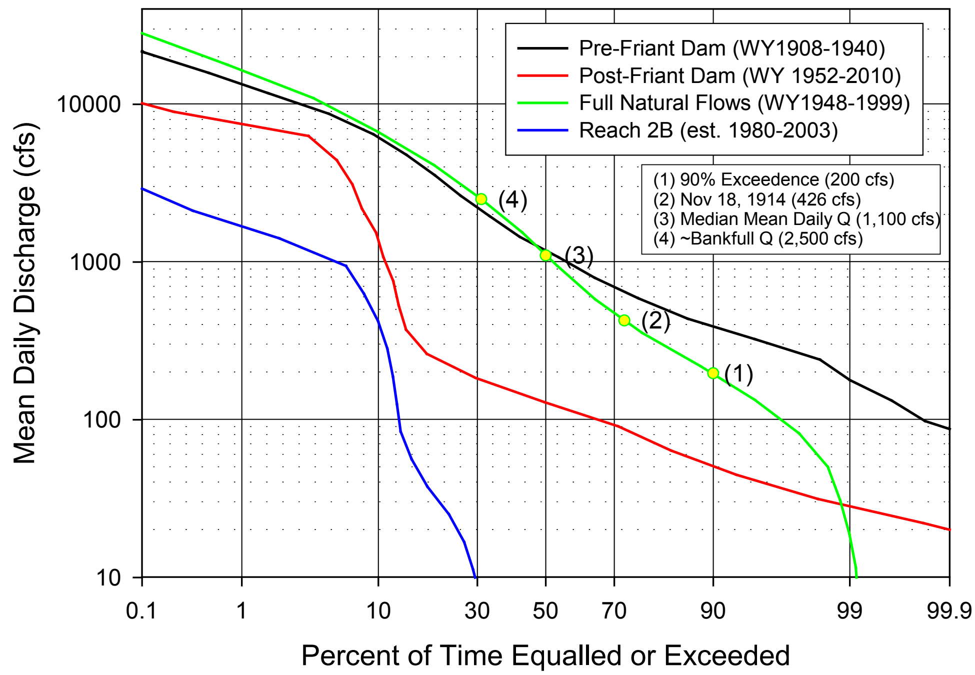


Figure 14-5.
Average Slope of the San Joaquin Valley and River between Friant Dam and the Merced River



Note: Also shown is the estimated flow-duration curve in Reach 2B for a portion of the post-Friant Dam period.

Figure 14-6.
Mean Daily Flow Duration Curves at the Friant Gage under Full Natural Flow, Pre-Friant Dam and Post-Friant Dam Conditions

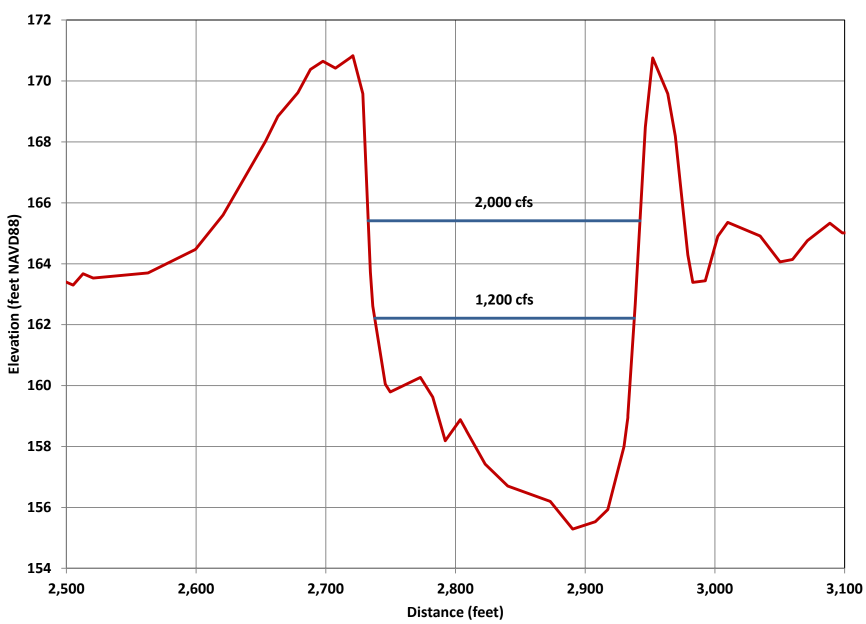
The main channel in Reach 2B typically has a wide, relatively shallow cross-section shape, with bed material that is generally in the medium- to coarse-sand size range (Figures 14-7 and 14-8). Channel widths in the portions of the reach outside the backwater effects of Mendota Dam are in the range of 200 to 400 feet, and average about 250 feet (Figure 14-9). Based on one-dimensional hydraulic modeling using the 2009 LiDAR (Light Detection and Ranging) data, typical cross-sectionally averaged flow depths at discharges in the range of the restoration releases vary from 2.5 to 7 feet, averaging 4 feet at 1,250 cfs and about 6 feet at 2,000 cfs (Figure 14-10).[3] The hydraulic model results also indicate that the bankfull capacity (based on the ground overbank elevations outside the local levees)[4] is about 1,600 cfs in the downstream portion of the reach between San Mateo Avenue and the head of Mendota Pool and about 2,100 cfs in the upstream portion of the reach between San Mateo Avenue and the Chowchilla Bifurcation Structure (Figure 14-11).

The lower capacity downstream from San Mateo Avenue is caused by a combination of sediment deposition and areas of relatively thick instream and riparian vegetation both associated with backwater effects from Mendota Dam (Figures 14-12 and 14-13). San Mateo Avenue is currently a low-water crossing with an approximately 5-foot-diameter culvert through the embankment that begins to overtop at less than 320 cfs. This crossing

[3] Note that the depth varies outside this range in local areas.
[4] The bankfull capacity occurs where the stream completely fills its channel at maximum capacity.

provides grade control and has a limited effect on the upstream water-surface profile and associated hydraulic conditions.

Figure 14-7.
View Looking Upstream of the San Joaquin River near the Apex of the Bend about River Mile 213.3, Downstream from the Chowchilla Bypass



Note: Also shown are the modeled water-surface elevations at 1,200 and 2,000 cfs based on 2009 LiDAR topography.

Figure 14-8.
Main Channel Cross Section Profile in the Vicinity of River Mile 213.3 (Downstream View)

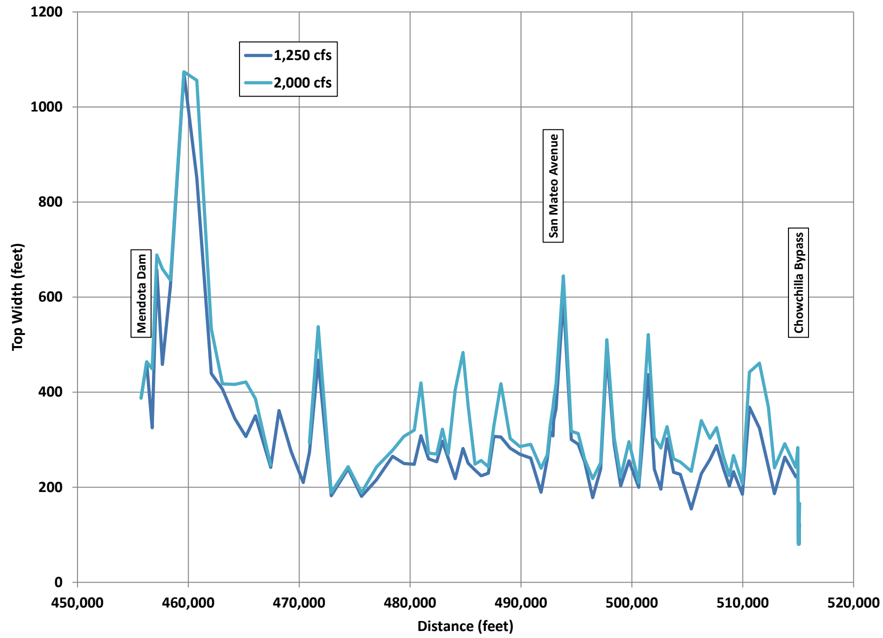


Figure 14-9.
Modeled Top Widths along Reach 2B at Discharges of 1,200 and 2,000 cfs based on 2009 LiDAR Topography

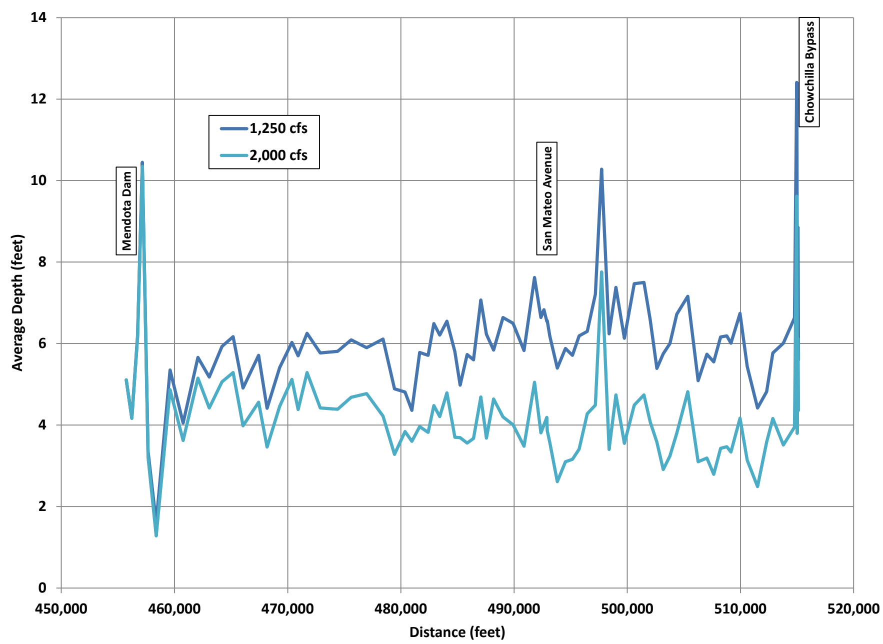


Figure 14-10.
Modeled Cross-Sectionally-Averaged Flow Depths along Reach 2B at Discharges of 1,200 and 2,000 cfs based on 2009 LiDAR Topography

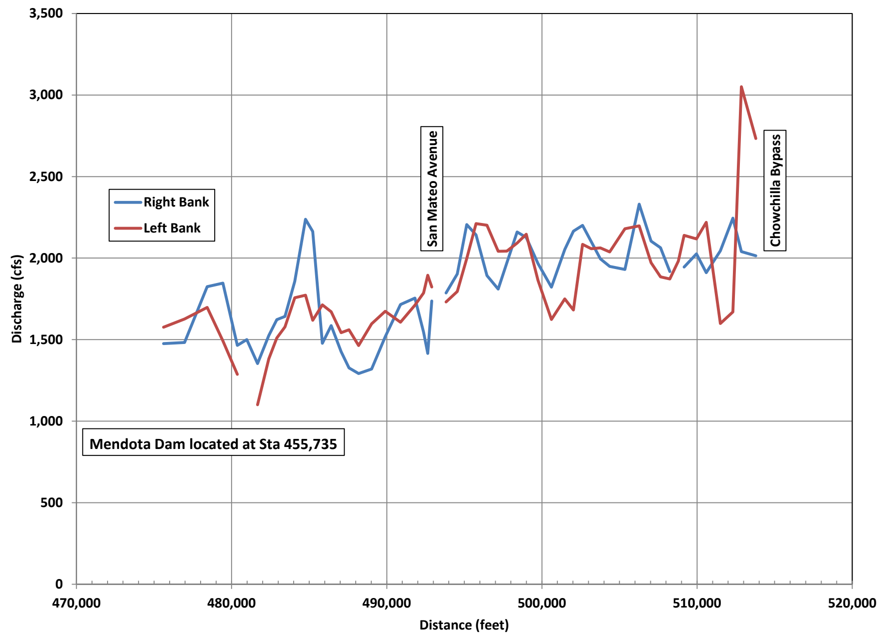
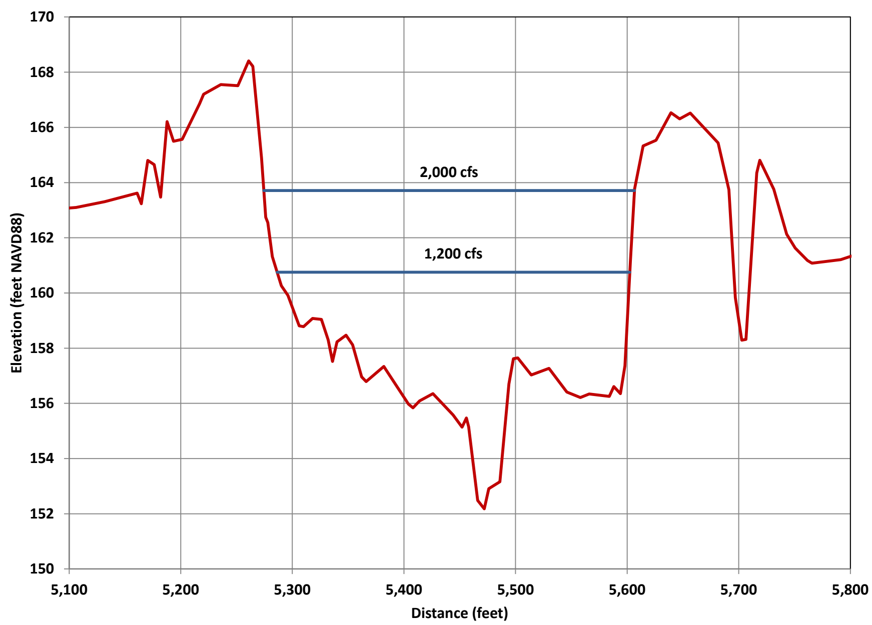


Figure 14-11.
Existing Bankfull Discharge in the Portions of Reach 2B Upstream from the Normal Backwater Effect of Mendota Dam based on the Ground Elevations Outside the Interior Levees

Note: Outlet of the ~5-foot diameter culvert is visible in the bottom-center of the photo and upstream edge of thick in-channel vegetation is visible in the background.

Figure 14-12.
View Looking Downstream from San Mateo Avenue



Note: Also shown are the modeled water-surface elevations at 1,200 and 2,000 cfs based on 2009 LiDAR topography.

Figure 14-13.
Main Channel Cross Section Profile about 500 feet Downstream from San Mateo Avenue, in the Area Shown in Figure 12 (Downstream View)

Based on hydraulic modeling using the topography from the 1914 California Debris Commission mapping, the in-channel capacity was about 2,500 cfs, 20 to 30 percent higher than the existing capacity. Although a significant amount of the sediment carried by the river from upstream has been diverted into the Chowchilla Bypass since construction of the flood-control system in the 1960s (as evidenced by the approximately 200,000 cubic yard sediment trap in the Chowchilla Bypass just downstream of the Chowchilla Bifurcation Structure [Figure 14-14]), sediment-continuity analysis by Tetra Tech (2011) and sediment-transport modeling by Reclamation (2011) indicate that Reach 2B is slightly aggradational[5] under existing conditions. This aggradation, coupled with the thick in-channel vegetation downstream from San Mateo Avenue, is the likely cause of the decrease in channel capacity over the past century.

[5] The streambed is being elevated slightly due to sediment deposition.

Figure 14-14.
View of 200,000 Cubic Yard Sediment Trap in the Chowchilla Bypass just Downstream from the Chowchilla Bifurcation Structure

The geomorphic literature indicates that the bankfull capacity in self-adjusted channels is typically in the range of the mean annual (i.e., 1.5- to 2-year) flood peak, although this can vary widely from less than the 1.5-year up to the 5-year or higher flood peak, depending on local conditions (Williams 1978, Wolman and Miller 1960). The 2-year flood peak under unregulated conditions was approximately 11,000 cfs (U.S. Army Corps of Engineers [Corps] and DWR 2002), and the discharge at the Friant gage, located about 50 miles upstream from the head of Reach 2B,[6] exceeded 2,500 cfs about 30 percent of the time (or about 110 days per year, on average) prior to significant water-resources development in the basin (Corps and DWR 2002) (see Figure 14-6). The duration of flows above 2,500 cfs decreased only slightly, to about 100 days per year during the early part of the 20th century, as water-resources development continued to occur prior to construction of Friant Dam. The overbanks were, thus, inundated for extended periods of time essentially every year, with flow passing from the main channel into a series of distributary channels, including Lone Willow Slough in the vicinity of the Chowchilla Bifurcation Structure. The locations of these distributary channels in the San Joaquin River floodplain can be clearly seen in the detailed National Resources Conservation Service (NRCS) (1990 and 2006) soils mapping, particularly on the north side of the river (see Hydrologic Soils Group [HSG] A soils in Figure 14-15).

[6] Although flow losses of up to 250 cfs occur in the 50-mile reach, these losses are less significant at higher flows; thus, the high flow data from the Friant gage are reasonably representative of flows reaching the head of Reach 2B.

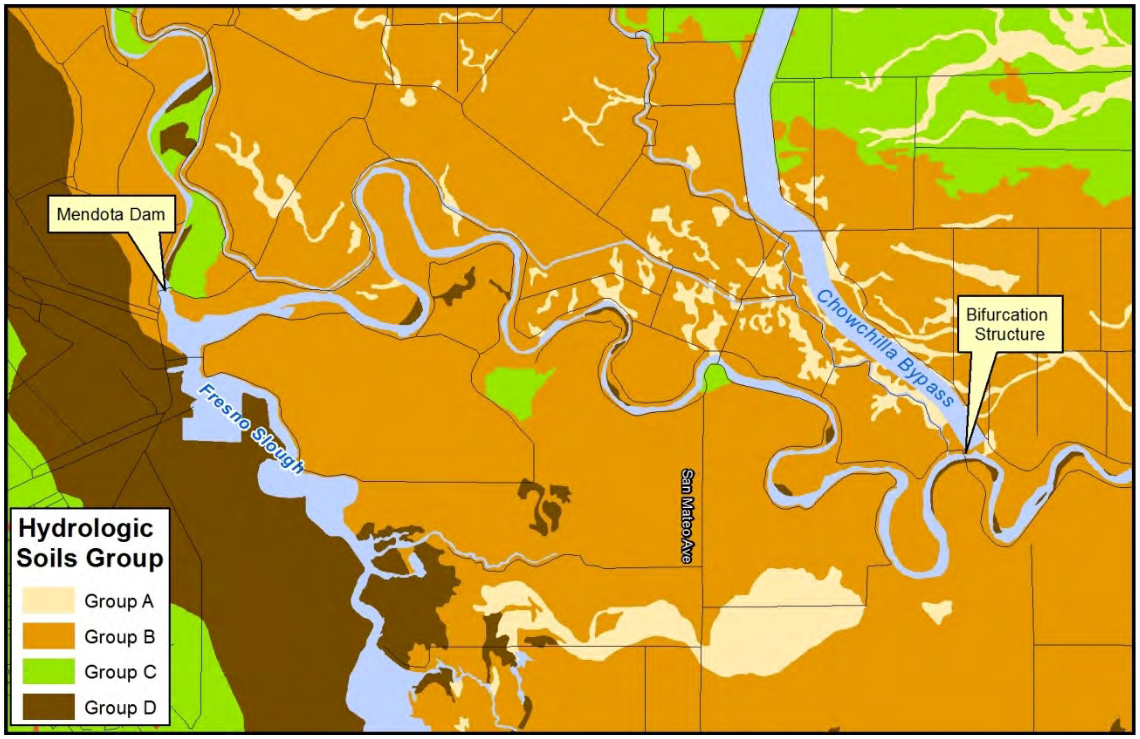


Figure 14-15.
Hydrologic Soil Groups in Floodplain of Reach 2B

According to Ouchi (1983), the reach from about Gravelly Ford downstream through Reach 2B is the modern-day alluvial fan of the San Joaquin River which explains the presence of the distributary channels and low main channel capacity. The cross-valley profile near the head of Reach 2B, in which the topography generally slopes downward away from the river, is consistent with the anticipated profile of a valley-floor fan, corroborating the conclusions of Ouchi (1983) (Figure 14-16).

Most of the floodplain soils along Reach 2B outside the overflow channels are categorized as HSG B, which means that they are typically composed of loamy sand or sandy loam with 10- to 20-percent clay and 50- to 90-percent sand. These soils have moderately low runoff potential when wet and are moderately susceptible to erosion. The HSG A soils tend to contain a greater percentage of sand, reflecting the higher flow energy in the overflow channels, compared to the floodplain areas outside these channels. These soils provide excellent growth media for riparian vegetation where they are exposed in the river banks which accounts for the limited amount of bank erosion and channel migration that has occurred since the mid- to late-1800s. The presence of the HSG A soils suggest that the overbank soils that would be the foundation for any future levees along the reach are highly variable, a factor that will be very important in designing the levee foundations.

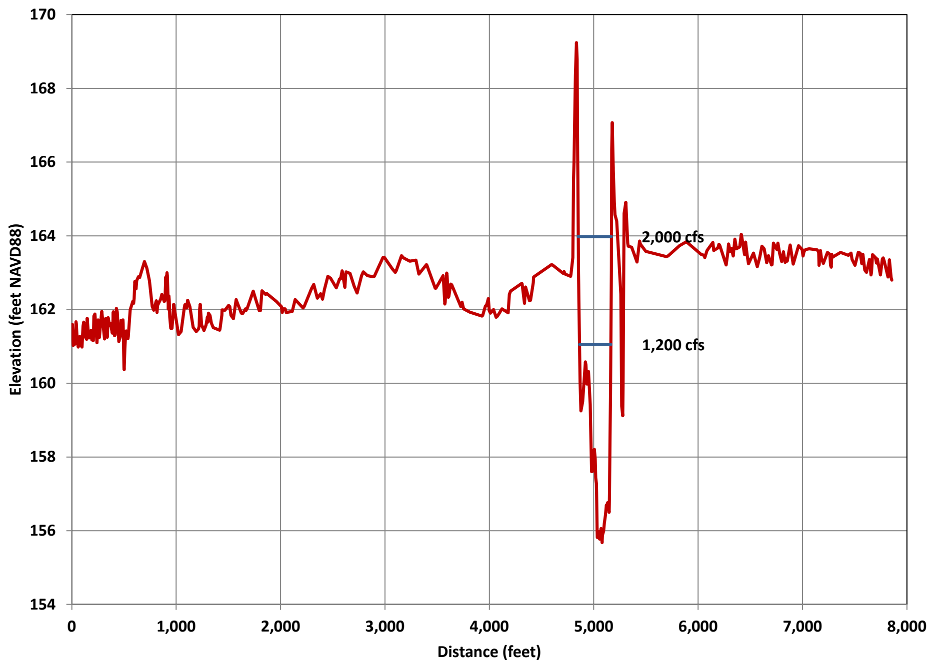


Figure 14-16.
Typical Cross Section Profile of San Joaquin River and Overbanks about River Mile 212.1, Downstream from the Chowchilla Bifurcation Structure

14.1.4 Water Quality

The primary source of water at the upstream end of Reach 2B (i.e., releases from Friant Dam) is generally considered very good in terms of water quality, having low temperature, low salinity, high dissolved oxygen, low nutrient concentrations, and no known problems with trace elements or pesticides (McBain and Trush, Inc. 2002). However, surface water quality in the Project area can be degraded due to low river flows, agricultural operations, and illegal dumping, resulting in increased concentrations of salts, pesticides, nutrients (from fertilizers), and trash and debris. Percolating rainfall and excess irrigation water leach these constituents downwards from fields into the shallow aquifer; the shallow aquifer has a hydrologic connection to local ditches, canals and the river. Stormwater runoff and agricultural return flows mobilize the same set of contaminants from fields into local receiving waters. Deliveries of Sacramento-San Joaquin Delta water to Mendota Pool via the DMC also affect water quality in the lower part of the Project area. In addition, abandoned mill and mine sites in the New Idria mining area of San Benito County within the Kings River/Fresno Slough watershed may contribute mercury and arsenic to Mendota Pool.

Table 14-4 lists general water quality indicator data for several stations in the vicinity of Reach 2B. Electrical conductivity (EC), expressed in microsiemens per centimeter (μS/cm), is used as a proxy for salinity since EC concentrations increase with increasing salt concentrations and EC is generally proportional to salinity. Stations on the San Joaquin River at Gravelly Ford (above Reach 2B) and below the Chowchilla Bifurcation (at the upstream end of Reach 2B) (i.e., stations GRF and SJB) are distinguished from lower stations by their relatively low EC with average concentrations of 44 µS/cm and 45 µS/cm respectively. The DMC (station DM3), with an average EC concentration of 510 µS/cm, is the primary source of water for the Mendota Pool. The impact of DMC imports on San Joaquin River water quality is evident at the San Joaquin River station near Mendota where average EC concentrations were 465 µS/cm (from April 1951 to September 1984) and 329 µS/cm (from November 2009 to September 2011). A similar pattern between upstream and downstream stations is seen with pH data (but not turbidity); however, pH and turbidity measurements were not reported for DM3.

A more extensive suite of constituents (including total suspended solids, nutrients, total and dissolved organic carbon, bacteria, and trace elements) have been monitored monthly by the Interim Flows program beginning October 2009. The program targets several stations along the San Joaquin River including San Joaquin River at Gravelly Ford and San Joaquin River below Mendota Dam (SJRRP 2013). Average concentrations of select parameters are listed for these stations in Table 14-5. In general, concentrations of total suspended solids, nutrients, boron, chromium, copper, mercury, nickel, selenium, and zinc are higher at the downstream station (below Mendota Dam) compared to the upstream station (Gravelly Ford).

The Interim Flows program also sampled for a large suite of pesticides (organochlorine, pyrethroids, carbamates, organophosphates) on April 6, 2011. The only pesticide that exceeded detection limits was alpha-hexachlorocyclohexane (alpha-HCH), an organochlorine pesticide which was measured at San Joaquin River below Mendota Dam at a concentration of 0.002 micrograms per liter (µg/L). The compound alpha-HCH is a byproduct of the production of the insecticide lindane. There are no aquatic life water quality objectives for alpha-HCH; however, the California Toxics Rule (CTR) drinking water criteria for the protection of human health (30-day average) is 0.0039 µg/L.

Table 14-4.
General Water Quality Indicators at Stations in the Vicinity of Reach 2B, San Joaquin River

Water Quality Parameter	Metric	RWQCB Water Quality Objective[1]	San Joaquin River at Gravelly Ford (GRF)[2]	San Joaquin River below Bifurcation (SJB)[2]	Delta-Mendota Canal Check 21 (DM3)[2]	San Joaquin River near Mendota (MEN)[3]	San Joaquin River near Mendota (SJRI_07)[4]	Mendota Wildlife Management Area (SJRI_011)[4]
Temperature (°F)	Average	--	63.5	66	64.3	--	65	68
	Range	--	39.7 - 87.8	47.4 - 86.2	45 - 80.8	--	49.6 - 80.1	60.1 - 79.9
	Period of Record	--	7/2/04 to 10/7/2011	11/16/09 to 10/7/2011	2/26/99 to 10/7/2011	no data	11/17/09 - 9/13/11	3/8/11 to 9/13/11
Electrical Conductivity (µS/cm)	Average	--	44	45	510	465	329	217
	Range	--	20 - 131	22 - 112	158 - 1256	31 - 1260	37 - 673	36 - 558
	Period of Record	--	7/2/04 to 10/7/2011	11/16/09 to 10/7/2011	3/26/99 to 10/7/2011	4/13/51 to 9/6/84	11/17/09 - 9/13/11	3/8/11 to 9/13/11
Turbidity (NTU)	Average	--	20	139	--	--	21	19.7
	Range	--	0 - 213	0.5 - 1206	--	--	4 - 41.5	14.3 - 27.2
	Period of Record	--	8/18/10 to 10/7/2011	11/16/09 to 10/7/2011	no data	no data	11/17/09 - 9/13/11	7/12/11 to 9/13/11
Dissolved Oxygen (mg/L)	Average	>7	10.2	-[5]	--	10	10.6	11
	Range	--	7.8 - 12.4	-[5]	--	7.8 - 11.7	6.1 - 18.6	7.3 - 18.6
	Period of Record	--	8/18/10 to 10/7/2011	11/16/09 to 10/7/2011	no data	11/14/79 to 9/10/80	3/3/10 - 9/13/11	3/8/11 to 9/13/11
pH (units)	Average	--	7	7.2	--	7.7	7.5	7.6
	Range	6.5 – 8.5	6.2 - 8.3	6.4 - 8.6	--	6.6 - 8.5	6.4 - 9.0	6.9 - 8.2
	Period of Record	--	8/18/10 to 10/7/2011	11/16/09 to 10/7/2011	no data	4/13/51 to 9/6/84	11/17/09 - 9/13/11	3/8/11 to 9/13/11

Source: DWR 2011, USGS 2011, SJRRP 2011a, RQWCB 2011

Notes:

[1] RWQCB 2011

[2] Data downloaded from California Data Exchange Center on October 7, 2011. Site location near Fresno Slough.

[3] Data downloaded from USGS National Water Information System for USGS station 11254000 on October 7, 2011.

[4] San Joaquin River Restoration Program Interim Flows Special Investigation Project.

[5] Data quality questionable.

Key:

ºF = degree Fahrenheit
µS/cm = microsiemen per centimeter
mg/L = miligrams per liter
NTU = nephelometric turbidity unit
RWQCB = Regional Water Quality Control Board
USGS = U.S. Geological Survey

Table 14-5.
Interim Flows Water Quality Data, San Joaquin River

Metric	Units	WQO	Upstream of Reach 2B[1]	Downstream of Reach 2B[2]
			Average[3]	Average[3]
Mean daily flow	cfs	--	845	838
Total Suspended Solids	mg/L	--	2.96	27.3
Nutrients				
Nitrate and Nitrite as N	mg/L	10	0.056	0.81
Nitrate as N	mg/L	10	0.034	0.59
Phosphorus, total as P	mg/L	--	0.069	0.28
Total Kjeldahl Nitrogen	mg/L	--	0.25	0.67
Total Organic Carbon	mg/L	--	3.2	3.1
Dissolved Organic Carbon	mg/L	--	3.2	3.2
Trace Elements, Total				
Arsenic	µg/L	10	1.60	1.79
Boron	µg/L	--	19.6	154
Chromium	µg/L	50	0.41	1.78
Copper	mg/L	1,300	1.08	3.0
Lead	µg/L	150	0.52	0.58
Mercury	ng/L	2,000	0.51	54.4
Molybdenum	µg/L	--	1.25	1.85
Nickel	µg/L	100	0.53	3.07
Selenium	µg/L	50	0.24	0.48
Sulfate	mg/L	--	1.43	39.6
Zinc	µg/L	5,000	2.91	5.90
Field Measurements				
pH	units	6.5-8.5	7.07	7.48
Conductivity	µS/cm	--	60.9	353
Turbidity	NTU	--	6.27	16.8
Dissolved Oxygen	mg/L	7	10.9	11.2
Temperature	°C	--	15.9	17.3

Source: SJRRP 2011a, RWQCB 2011

Notes:

[1] San Joaquin River at Gravelly Ford (Oct. 2009 - Jun. 2011)

[2] San Joaquin River below Mendota Dam (Oct. 2009 - Jun. 2011)

[3] Data reported as non-detect were treated as half the detection limit.

Key:

ºC = degree Celsius
µg/L = microgram per liter
µS/cm = microsiemen per centimeter
cfs = cubic feet per second
mg/L = miligrams per liter
NA = Not available
ng/L = nanograms per liter
NTU = nephelometric turbidity unit
RWQCB = Regional Water Quality Control Board
WQO = water quality objective

Sediment Quality

As part of the Interim Flows program, bed sediment samples collected at target stations in fall and winter 2009 and spring 2010 were analyzed for metals, trace elements, and toxicity. More comprehensive sediment sampling was conducted in fall/winter 2011 by the SJRRP to characterize sediments in Mendota Pool, many of which are expected to erode from the existing pool area as a result of Project alternatives which lower Mendota Dam (SJRRP 2011e, SJRRP 2012). A total of 13 volume-proportional composite samples were collected from drill holes advanced between Mendota Dam and 4.7 miles upstream in the San Joaquin river arm of Mendota Pool, including a background sample composited from sediment collected between approximately RM 206.5 and RM 209.5. Elutriate[7] was sampled to estimate the concentrations of chemicals that are likely to be released to the water column should Mendota Pool sediments become suspended or transported. Sediment and elutriate samples were analyzed for physical properties, "constituents of potential concern" (metals, pesticides, and organic compounds), and acute toxicity.

Analytical results from the 2009/2010 Interim Flows program and the 2011 SJRRP study were compared to several applicable sediment and water quality standards to identify chemicals that may be present at potentially harmful concentrations to freshwater aquatic life and human health (SJRRP 2012). Sediment concentrations of some constituents exceed one or more of the screening quick reference tables toxicity thresholds that predict "unlikely" adverse sediment impacts, including four metals (arsenic, chromium, copper, and nickel) and two organic pesticides (4,4'-dichlorodiphenyldichloroethane [DDD] and 4,4'-dichlorodiphenyldichloroethylene [DDE]). However, toxicity test results did not show significantly increased mortality of test organisms, and no chemical analytes were detected at concentrations exceeding Dredged Material Management Program Disposal Procedures Users' Manual bioaccumulation triggers; therefore, the SJRRP study concluded that sediment within Mendota Pool is not likely to have an adverse effect on the benthic community (SJRRP 2012).

Concentrations of several constituents in the elutriate exceeded water quality objectives from the Water Quality Control Plan for the Sacramento and San Joaquin River Basins (Basin Plan) and CTR water quality standards. These include EC, ammonia as nitrogen, metals (aluminum, arsenic, barium, cadmium, copper, iron, lead, manganese, mercury, and molybdenum) and organic pesticides (4,4'-DDD, total DDD, 4,4'-DDE, and total DDE). In addition, toxicity tests on elutriate samples from lower- and middle-pool regions showed significant reductions in survival of test organisms. Based on these findings, the SJRRP study concluded that Mendota Pool sediment suspended in the water column could increase chemical concentrations to levels that violate promulgated Basin Plan objectives and CTR water quality standards (SJRRP 2012).

[7] Elutriate is formed by vigorously mixing one part sediment to four parts water, allowing the mixture to settle, and then centrifuging to remove particulates. The resulting fluid is termed "elutriate."

Beneficial Uses and Listed Waterbodies

The beneficial uses designated by the Central Valley Regional Water Quality Control Board (RWQCB) for the San Joaquin River between Friant Dam and the Mendota Pool include the following (RWQCB 2011):

- Municipal and domestic supply.
- Agriculture irrigation and stock watering.
- Industrial process supply.
- Contact and non-contact water recreation.
- Warm and cold freshwater habitat.
- Migration of aquatic organisms (warm and cold).
- Spawning, reproduction, and/or early development.
- Wildlife habitat.

No beneficial uses have been specifically designated for Fresno Slough. State policy, however, is that the beneficial uses for a specific water body generally apply to its tributaries.

San Joaquin River between Friant Dam and Mendota Pool is identified on the Clean Water Act (CWA) Section 303(d) list as impaired by invasive species with an unknown source. The Total Maximum Daily Load (TMDL) plan to correct the impairment is scheduled for completion in 2019. Mendota Pool is listed as impaired by mercury caused by resource extraction; TMDL completion is scheduled for 2021. Mendota Pool is also listed for selenium with agriculture, agricultural return flows, and groundwater withdrawal identified as potential sources; TMDL completion is scheduled for 2019. The reach of the San Joaquin River immediately downstream of Reach 2B, between the Mendota Pool and Bear Creek, is listed for boron, chlorpyrifos, dichlorodiphenyl-trichloroethane (DDT), diazinon, EC, Group A (restricted) pesticides, and unknown toxicity. Agriculture is identified as the potential source for all of these pollutants except unknown toxicity, for which the source is unknown. A TMDL for diazinon and chlopyrifos was approved by the EPA in December 2006.

14.2 Regulatory Setting

This section focuses on laws related directly to surface water and water quality. The majority of this discussion is taken directly from the Program Environmental Impact Statement/Report (PEIS/R) (SJRRP 2011b, pages 14-7 to 14-11). A number of regulatory authorities at the Federal, State, and local levels control the flow, quality and supply of water in California, either directly or indirectly. At the State level, the State Water Resources Control Board (SWRCB) and the Central Valley RWQCB regulate water quality in San Joaquin River. The EPA also plays an important role under the auspices of the Federal CWA and Safe Drinking Water Act. The California Department of Health

Services (DHS) has an interest in the Delta because the Delta is the source of drinking water for over 25 million Californians.

14.2.1 Federal

This section presents the applicable Federal regulations associated with surface water and water quality.

Safe Drinking Water Act

The Safe Drinking Water Act was established to protect the quality of drinking water in the United States. The Safe Drinking Water Act authorized EPA to set National health-based standards for drinking water, and requires many actions to protect drinking water and its sources, including rivers, lakes, reservoirs, springs, and groundwater wells. Furthermore, the Safe Drinking Water Act requires all owners or operators of public water systems to comply with primary (health-related) standards. EPA has delegated to the DHS, Division of Drinking Water and Environmental Management, the responsibility for administering California's drinking-water program.

Clean Water Act

The CWA is the primary Federal legislation governing the water quality aspects of the Project. The objective of the act is "to restore and maintain the chemical, physical, and biological integrity of the nation's waters." The CWA establishes the basic structure for regulating discharge of pollutants into the waters of the United States and gives EPA the authority to implement pollution control programs such as setting wastewater standards for industries. In certain states such as California, EPA has delegated authority to state agencies.

Section 303. Section 303 of the CWA requires states to adopt water quality standards for all surface waters of the United States. The three major components of water quality standards are designated users, water quality criteria, and antidegradation policy. Section 303(d) of the CWA requires states and authorized Native American tribes to develop a list of water-quality-impaired segments of waterways. The list includes waters that do not meet water quality standards necessary to support the beneficial uses of a waterway, even after point sources of pollution have installed the minimum required levels of pollution control technology. Only waters impaired by "pollutants" (including clean sediments, nutrients such as nitrogen and phosphorus, pathogens, acids/bases, temperature, metals, cyanide, and synthetic organic chemicals, not those impaired by other types of "pollution" (e.g., altered flow, channel modification), are to be included on the list.

Section 303(d). Section 303(d) of the CWA also requires states to maintain a list of impaired water bodies so that a TMDL can be established. A TMDL is a plan to restore the beneficial uses of a stream or to otherwise correct an impairment. It establishes the allowable pollutant loadings or other quantifiable parameters (e.g., pH, temperature) for a water body and thereby provides the basis for establishing water quality-based controls. The calculation for establishing TMDLs for each water body must include a margin of safety to ensure that the water body can be used for the purposes of State designation. Additionally, the calculation also must account for seasonal variation in water quality.

Central Valley RWQCB develops TMDLs for the San Joaquin River (see discussion on the Porter-Cologne Water Quality Control Act below).

Section 401. Section 401 of the CWA requires Federal agencies to obtain certification from the State or Native American tribes before issuing permits that would result in increased pollutant loads to a water body. The certification is issued only if such increased loads would not cause or contribute to exceedances of water quality standards.

Section 402. Section 402 of the CWA creates the National Pollutant Discharge Elimination System (NPDES) permit program. This program covers point sources of pollution discharging into a surface water body.

Section 404. A permit must be obtained from the Corps under Section 404 of the CWA for the discharge of dredged or fill material into "waters of the United States, including wetlands." Waters of the United States include wetlands and lakes, rivers, streams, and their tributaries. Wetlands are defined for regulatory purposes as areas inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support and, under normal circumstances do support, vegetation typically adapted for life in saturated soil conditions.

Antidegradation Policy

The Antidegradation Policy, established in 1968 and revised in 2005 (40 Code of Federal Regulations [CFR], Section 131.12), is designed to protect existing uses and water quality and National water resources, as authorized by Section 303(c) of the CWA. This policy protects water bodies where existing quality is higher than necessary for protection of beneficial uses. It states that high quality waters will be maintained unless a change in water quality is (1) consistent with maximum benefit to the people of the State, (2) will not unreasonably affect present and anticipated beneficial uses of the water, and (3) will not result in water quality less than that prescribed in policies.

Rivers and Harbors Act Section 10

Section 10 of the Rivers and Harbors Act (33 United States Code 401 et seq.) requires authorization from the Corps for construction of any structure over, in, or under navigable waters of the United States.

National Flood Insurance Program

The Federal Emergency Management Agency (FEMA) is responsible for determining flood elevations and floodplain boundaries and distributing Flood Insurance Rate Maps, which are used in the National Flood Insurance Program. Flood Insurance Rate Maps identify the locations of special flood hazard areas, including the 100-year and 500-year floodplain. Federal regulations governing development in a Zone A (100-year) floodplain are set forth in 44 CFR, Part 60, which enables FEMA to require municipalities that participate in the National Flood Insurance Program to adopt certain flood hazard reduction standards for construction and development within floodplains. In the Project area and vicinity, the FEMA program is overseen by the Fresno County Department of Public Works and Planning Development Engineering Section and the Madera County Flood Control and Water Conservation District.

Federal Insecticide, Fungicide, and Rodenticide Act

The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) was first passed in 1947 to establish labeling provisions and procedures for registering pesticides with the U.S. Department of Agriculture. It was rewritten in 1972 and has since been amended several times. In its current form, FIFRA mandates that EPA regulate the use and sale of pesticides to protect human health and preserve the environment. Registration with the EPA assures that pesticides would be properly labeled and that, if used in accordance with specifications, they would not cause unreasonable harm to the environment. Pesticide use in California is also regulated by the California Department of Pesticide Regulation (DPR) and local County Agricultural Commissioners.

14.2.2 State of California

This section presents the applicable State regulations associated with surface water quality.

Porter-Cologne Water Quality Control Act

The Porter-Cologne Water Quality Control Act is California's statutory authority for protecting water quality. Under the act, the State must adopt water quality policies, plans, and objectives protecting the State's waters for the use and enjoyment of people. Obligations of SWRCB and the RWQCBs to adopt and periodically update their Water Quality Control Plans (e.g., Basin Plans) are set forth in the act. A Basin Plan identifies the designated beneficial uses for specific surface water and groundwater resources, applicable water quality objectives necessary to support the beneficial uses, and implementation programs that are established to maintain and protect water quality from degradation for each of the RWQCBs. The act also requires waste dischargers to notify the RWQCBs of their activities through filing reports of waste discharge, and authorizes SWRCB and the RWQCBs to issue and enforce waste discharge requirement, NPDES permits, Section 401 water quality certifications, or other approvals. The RWQCBs also have authority to issue waivers for waste discharge reports/waste discharge requirements for broad categories of "low threat" discharge activities that have minimal potential for adverse water quality effects when implemented according to prescribed terms and conditions.

Water quality objectives established in the Basin Plan for the Sacramento River and San Joaquin River Basins (RWQCB 2011) to protect the beneficial uses from the types of potential pollutants that could be generated by the Project are included in Table 14-6.

Table 14-6.
Basin Plan Water Quality Objectives to Protect Beneficial Uses

Parameter	Water Quality Objective
Dissolved Oxygen	5.0 mg/L minimum in waters designated WARM 7.0 mg/L minimum in waters designated COLD 7.0 mg/L minimum in waters designated SPWN The monthly median of the mean daily dissolved oxygen concentration shall not fall below 85 percent of saturation in the main water mass, and the 95 percentile concentration shall not fall below 75 percent saturation.
Salinity	Electrical conductivity shall not exceed 150 µS/cm from Friant Dam to Gravelly Ford.
Suspended Material and Settleable Material	Waters shall not contain substances or suspended material in concentrations that cause nuisance or adversely affect beneficial uses.
Sediment	The suspended sediment load and suspended sediment discharge rate of surface waters shall not be altered in such a manner as to cause nuisance or adversely affect beneficial uses.
Turbidity	Waters shall be free of changes in turbidity that cause nuisance or adversely affect beneficial uses. Increases in turbidity attributable to controllable water quality factors shall not exceed: 1 NTU where natural turbidity is between 0 and 5 NTUs; 20 percent where natural turbidity is between 5 and 50 NTUs; 10 NTUs where natural turbidity is between 50 and 100 NTUs; or 10 percent where natural turbidity is greater than 100 NTUs.
pH	The pH shall not be depressed below 6.5 nor raised above 8.5. Changes in normal ambient pH levels shall not exceed 0.5 in fresh waters designated with COLD or WARM beneficial uses.
Oil and Grease	Waters shall not contain oils, greases, waxes, or other materials in concentrations that cause nuisance, result in visible film or coating on the surface of the water or on objects in the water, or that otherwise adversely affect beneficial uses.
Floating Material	Waters shall not contain floating material in amounts that cause nuisance or adversely affect beneficial uses.
Temperature	The natural receiving water temperature intrastate waters shall not be altered unless it can be demonstrated that such alteration in temperature does not adversely affect beneficial uses. At no time or place shall the temperature of COLD or WARM intrastate waters be increased more than 5ºF (2.8ºC) above natural receiving water temperature.
Toxicity	All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life. This objective applies regardless of whether the toxicity is caused by a single substance or the interactive effect of multiple substances. Compliance with this objective would be determined by analyses of indicator organisms, species diversity, population density, growth anomalies, and biotoxicity tests of appropriate duration or other methods as specified by the RWQCB
Pesticides	No individual pesticide or combination of pesticides shall be present in concentrations that adversely affect beneficial uses. Below Mendota Dam, the following objectives apply and should not be exceeded more than once in a three year period. Chlorpyrifos: 0.025 µg/L (1-hour average), 0.015 µg/L (4-day average) Diazinon: 0.16 µg/L (1-hour average), 0.10 µg/L (4-day average)

Source: RWQCB 2011

Key:
ºC = degree Celsius
ºF = degree Fahrenheit
µg/L = microgram per liter
µS/cm = microsiemen per centimeter
mg/L = miligrams per liter
NTU = nephelometric turbidity unit
RWQCB = Regional Water Quality Control Board

California Toxics Rule

On May 18, 2000, the EPA published the CTR in the Federal Register, adding Section 131.38 to 40 CFR and establishing new water quality objectives for some constituents in the Basin Plans. On May 22, 2000, the Office of Administrative Law approved, with modifications, the Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California (Phase 1 of the Inland Surface Waters Plan and Enclosed Bays and Estuaries Plan). The Policy establishes implementation procedures for three categories of priority pollutant criteria or water quality objectives. These are:

- Criteria promulgated by the EPA in the National Toxics Rule that apply in California.
- Criteria proposed by the EPA in the CTR.
- Water quality objectives contained in RWQCB Basin Plans.

NPDES General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities

Construction activities on 1 acre or more are subject to the permitting requirements of the *NPDES General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities* (Construction General Permit) Order No. 2009-0009-DWQ, NPDES No. CAS000002 (SWRCB 2009). The SWRCB established the Construction General Permit program to regulate stormwater discharges from construction sites. The Construction General Permit implements a risk-based permitting approach, specifies minimum best management practice (BMP) requirements, and requires monitoring and reporting activities. The Construction General Permit establishes three 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 the Project is likely to be categorized as either Risk Level 2 or 3 depending on the construction schedule.

The Construction General Permit requires preparation and implementation of a stormwater pollution prevention plan (SWPPP), which would provide BMPs to minimize potential short-term increases in transport of sediment and other pollutants caused by construction. Typical BMPs include:

- Implementing practices to minimize the contact of construction materials, equipment, and maintenance supplies with stormwater.
- Limiting fueling and other activities using hazardous materials to designated areas, providing drip pans under equipment, and daily checks for vehicle condition.
- Implementing practices to reduce erosion of exposed soil, including stabilization for soil stockpiles, watering for dust control, perimeter silt fences, and/or placement of fiber rolls.
- Implementing practices to maintain water quality including silt fences, stabilized construction entrances, and storm drain inlet protection.

- 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.
- Developing spill prevention and emergency response plans to handle potential fuel or other spills.
- Where feasible, limiting construction to dry periods.

Waste Discharge Requirements for Dewatering and Other Low Threat Discharges to Surface Waters

The General Order for *Dewatering and Other Low Threat Discharges to Surface Waters*, RWQCB Order No. R5-2008-0081, is a general permit covering discharges of construction dewatering under the following circumstances: the discharge does "not contain significant quantities of pollutants and they are either (1) four months or less in duration, or (2) the average dry weather discharge does not exceed 0.25 million gallons per day."

California Water Code (Water Rights)

A water right is a legally protected right, granted by law, to take control of water and to put it to beneficial use. Under the California Water Code, the SWRCB is responsible for allocating surface water rights and permitting the diversion and use of water throughout the State. Through its Division of Water Rights, the SWRCB issues permits to store and to divert water for new appropriations and it authorizes changes to existing water rights. SWRCB attaches conditions to these permits to ensure that the water user prevents waste, conserves water, does not infringe on the rights of others, and puts the State's water resources to the most beneficial use.

An applicant, permittee, or licensee who wishes to change the point of diversion, place of use, or purpose of use from that specified in an existing permit or license must petition SWRCB to amend a water right. When considering a petition for a water right amendment, SWRCB considers the same factors as those it considers when a water user applies for a new permit, such as waste prevention, water conservation, infringement on the rights of others, and public trust values.

California Pesticide Regulatory Program

The DPR regulates the sale and use of pesticides in California. DPR is responsible for reviewing the toxic effects of pesticide formulations and determining whether a pesticide is suitable for use in California through a registration process. Although DPR cannot require manufacturers to make changes in labels, it can refuse to register products in California unless manufacturers address unmitigated hazards by amending the pesticide label. Consequently, many pesticide labels that are already approved by EPA also contain California-specific requirements. Pesticide labels are legal requirements and include instructions telling users how to make sure the product is applied only to target pests including precautions the applicator should take to protect human health and the environment. For example, product labels may contain such measures as restrictions in certain land uses and weather (i.e., wind speed) parameters. DPR is also responsible for examining and licensing qualified applicators, aircraft pilots, pest control dealer designated agents, and agricultural pest control advisers; and for certifying pesticide applicators who use or supervise the use of restricted pesticides.

14.2.3 Regional and Local

Irrigated Lands Regulatory Program

The Irrigated Lands Regulatory Program was initiated in 2003 to prevent agricultural runoff from impairing surface waters. Irrigated lands are lands where water is applied for producing crops, including row, field, and tree crops, as well as commercial nurseries, nursery stock production, managed wetlands, and rice production. Except where the Central Valley RWQCB has adopted geographically-based or commonly based waste discharge requirements, irrigated agriculture lands enrolled in a coalition group are subject to a conditional waiver.

New waste discharge requirements are being developed under the Long-term Irrigated Lands Regulatory Program that address irrigated agricultural discharges throughout the Central Valley. The Central Valley RWQCB adopted Order No. R5-2012-0116 for the Eastern San Joaquin River Watershed and developed draft requirements for the Western San Joaquin River Watershed as part of the Long-term Irrigated Lands Regulatory Program.

Pesticide Use Permits

In addition to Federal and State oversight, County Agricultural Commissioners in California also regulate the sale and use of pesticides and issue use permits for applications of pesticides that are deemed as restricted materials by DPR. County Agricultural Commissioners also collect pesticide use reports and investigate incidents and illnesses.

Fresno County General Plan

The Fresno County General Plan (2000) contains numerous policies to protect and enhance the surface water and groundwater resources in the county. Policies OS-A.1 through OS-A.30 address broad water planning issues, groundwater recharge, the relationship of land use decisions to water issues, and water quality problems. Policies PF-E.1 through PF-E.22 seek 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.

Fresno County Grading Ordinance

The Fresno County Code includes a grading ordinance that sets forth regulations for control of excavating, grading, earthwork construction, including fills or embankments and related work.

Madera County General Plan

The Madera County General Plan (adopted October 24, 1995) also contains policies related to water resources. These policies address protection of percolation and ground-water recharge, control of sedimentation and excessive grading, avoidance of flood hazards, use of construction BMPs, and storm drainage and flood control (reference, for example: Policies 5.C.1 through 5.C.4, 5.C.7; Policies 3.E.1 through 3.E.6; and Policies 6.B.1 through 6.B.6).

Madera County Grading and Erosion Control

The Madera County Code includes a chapter on grading and erosion control that sets forth regulations for control of erosion, sedimentation, and other environmental damage resulting from excavations and related activities.

14.3 Environmental Consequences and Mitigation Measures

14.3.1 Impact Assessment Methodology

This section describes the approach for the analysis of surface water resources in the Project area, including geomorphology and water quality. Potential impacts to surface water diversions are evaluated and discussed in Chapter 23.0, "Utilities and Service Systems."

Geomorphology

The specific aspects of the Project that could affect the geomorphology of Reach 2B include the following:

- Changes in the discharge regime associated with the passage of Restoration Flows that significantly exceed pre-Restoration Flows, and the associated effect on both the sediment supply and in-channel energy to transport the sediment and erode the channel banks.
- Changes in sediment transport capacity due to changes in the channel hydraulics at any particular discharge due to changes in channel profile and cross-sectional shape that could affect the vertical and lateral stability of the main channel.
- Changes in water-surface profiles at the upstream end of Reach 2B that could affect bed material supply to the reach, and thus, the sediment balance (and aggradation/degradation tendencies) in the reach. These changes could also impact channel stability in the lower end of Reach 2A.
- Temporary increases in sediment supply to the downstream reaches due to increased erosion in Reach 2B as the channel adjusts to the higher Restoration Flows. This is particularly relevant to the alternatives that include Fresno Slough Dam, where the channel would downcut (or must be excavated to equilibrium grade) between Mendota Dam and San Mateo Avenue due to the base water surface level lowering associated with removal of the boards at Mendota Dam.
- Long-term increases in sediment supply to the downstream reaches due to the passage of higher Restoration Flows through Reach 2B.
- Changes in riparian vegetation caused by changes in the sustained flow under Restoration conditions in the upstream portion of Reach 2B and changes in the sustained water-surface elevations in the downstream portions of the reach. These changes could potentially impact in-channel capacity through changes in the overall hydraulic roughness and associated in-channel hydraulics, the overall

sediment transport capacity and sediment balance through the reach, the tendency for lateral erosion, and flood-carrying capacity.

- Increases in the magnitude and duration of overbank inundation associated with the higher Restoration Flows, removal of internal levees, and other overbank grading activities.

Numerous studies relating to the hydraulics, sediment transport and channel dynamics in Reach 2B for the various Project alternatives have previously been conducted (Mussetter Engineering, Inc. 2002, Tetra Tech 2011, Reclamation 2011). As a result, no new modeling studies were performed for this Environmental Impact Statement/Report; the impact analysis was performed by comparing quantitative estimates of the above factors based on results for the No-Action Alternative, four action alternatives, and existing conditions.

Water Quality

The evaluation of potential impacts to water quality due to the Project was primarily based on a comparison between existing, No-Action, and projected water quality and water quality objectives.

The Project would have the greatest potential to affect turbidity and constituents in sediment suspended by the Project. The Project could potentially generate suspended sediment loads to the river during construction and post-construction. These sediments may contain metals, pesticides, and other priority pollutants. Although the post-construction Reach 2B is expected to be primarily depositional, some alternatives may release suspended sediment related to localized erosion or scour as the channel reaches equilibrium.

14.3.2 Significance Criteria

Geomorphology

Specific thresholds for significance were based on criteria in the Environmental Checklist Form in Appendix G of the California Environmental Quality Act (CEQA) Guidelines, as amended, and other criteria as described below. Under National Environmental Policy Act (NEPA) Council on Environmental Quality (CEQ) Regulations, effects must be evaluated in terms of their context and intensity. Specific criteria that were used in assigning significance include the potential for the following:

- Substantially altering the existing drainage pattern of the site or area, including through the alteration of the course of the river, in a manner which would result in substantial erosion or siltation on- or off-site.
- Aggradation or degradation that causes a substantial increase in channel instability.
- Lateral erosion that could damage existing and/or proposed levees.
- Short- and long-term increases in sediment material load that could cause substantial increases in channel instability, loss of flood-carrying capacity, and reduced habitat quality in downstream reaches.

The significance of these potential changes was based on the magnitude of the change over existing conditions. Also considered are the likely effects of those changes on the ability of each alternative to meet restoration goals while continuing to meet flood-control and other public safety needs.

Water Quality

The thresholds of significance for impacts are based on the Environmental Checklist Form in Appendix G of the State CEQA Guidelines, as amended. Under NEPA CEQ Regulations, effects must be evaluated in terms of their context and intensity. These factors are considered when applying State CEQA Guidelines Appendix G. The Project would result in a significant impact on surface water resources and water quality if the Project would:

- Violate any water quality standards or waste discharge requirements.
- Create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff.
- Increases in suspended-sediment loads that could have a substantial adverse effect on downstream water quality.
- Otherwise substantially degrade water quality.

14.3.3 Impacts and Mitigation Measures

This section provides an evaluation of direct and indirect effects of the Project alternatives on surface water resources. It includes analyses of potential effects relative to No-Action conditions in accordance with NEPA and potential effects compared to existing conditions to meet CEQA requirements. Existing conditions for surface water resources assessment is defined as the beginning of Interim Flows in water year 2010, rather than July 2009 when the Notice of Preparation was released because of the wealth of data collected under the Interim Flows component of the SJRRP. The physical changes associated with Project alternatives are then identified as separate from the recent Interim Flows conditions. The analysis is organized by Project alternative with specific impact topics numbered sequentially under each alternative. With respect to surface water, the environmental impact issues and concerns are:

Geomorphology

1. Substantially Altering the Existing Drainage Pattern, Including Alteration of the Course of the River, in a Manner which would Result in Substantial On- or Off-Site Erosion.
2. Increased Aggradation or Degradation that Causes a Substantial Increase in Channel Instability within Reach 2B.
3. Increases in Lateral Erosion that Could Damage Existing and/or Proposed Levees or Other Infrastructure within Reach 2B.
4. Short- and Long-Term Increases in Sediment Load that Could Cause Substantial Increases in Channel Instability in Downstream Reaches.

Water Quality

1. Construction-Related Effects on Water Quality.
2. Long-Term Effects on Water Quality from Mobilization of Mendota Pool Sediments.
3. Long-Term Effects on Water Quality from Floodplain Inundation of Prior Agricultural Soils.
4. Long-Term Effects on Water Quality from Agricultural Practices within the New Floodplain.

Other surface water-related issues covered in the PEIS/R are not covered here because they are programmatic in nature and/or are not relevant to the Reach 2B Mendota Pool Bypass Project area. These include beneficial long-term effects on instream surface water quality resulting from increases in releases of high-quality water from Friant Dam.

No-Action Alternative

Under the No-Action Alternative, the Project would not be implemented and none of the Project features would be developed in Reach 2B of the San Joaquin River. However, other proposed actions under the SJRRP would be implemented, including habitat restoration in other reaches, augmentation of river flows, and reintroduction of salmon. Without the Project in Reach 2B, however, the terms of the Settlement would not be met. This section describes impacts of the No-Action Alternative. The analysis is a comparison to existing conditions and no mitigation is required for No-Action.

The No-Action Alternative would maintain existing levee alignments and heights, and maximum conveyance would continue to be limited to the existing channel capacity. The Chowchilla Bypass would continue to bypass flood flows that exceed the capacity of Reach 2B.

Geomorphology

Impact GEM-1 (No-Action Alternative): ***Substantially Altering the Existing Drainage Pattern, Including Alteration of the Course of the River, in a Manner which Would Result in Substantial On- or Off-Site Erosion***. Under the No-Action Alternative, none of the facilities that are part of the Project would be constructed, and there would not be a change from existing conditions in levee alignments. As a result, there would be no physical changes to the existing drainage patterns within the reach, and there would be **no impact** to channel geomorphology.

Impact GEM-2 (No-Action Alternative): ***Increased Aggradation or Degradation that Causes a Substantial Increase in Channel Instability within Reach 2B.*** Previous sediment transport analyses by Tetra Tech (2011) and sediment transport modeling by Reclamation (2011) indicate that Reach 2B is slightly aggradational under conditions associated with the No-Action Alternative and existing conditions. Because long-term sediment deposition rates would be similar, there would be **no impact** to aggradation or degradation trends in the reach.

Impact GEM-3 (No-Action Alternative): ***Increases in Lateral Erosion that Could Damage Existing and/or Proposed Levees or Other Infrastructure within Reach 2B***. Future lateral erosion in Reach 2B will depend on the magnitude and duration of the flows, the characteristics of the bank material, and the amount and characteristics of the riparian vegetation. Lateral adjustment could occur under the No-Action Alternative as the channel adjusts to the increased magnitude and duration of flows. As discussed in Section 14.1.3, the planform alignment of Reach 2B has not changed substantially since at least the early part of the 20th century, and more likely, since the mid-1800s. Prior to construction of Friant Dam in the early- to mid-1940s, much higher flows regularly passed through Reach 2B than during either the recent historical period (i.e., prior to the Interim Flows program) or during the Interim Flows period. Based on these historical observations and the likelihood that the higher sustained flows would result in more riparian vegetation that tends to stabilize the channel banks, substantial lateral erosion is not anticipated under the No-Action Alternative. The impact to lateral erosion would be **less than significant**.

Impact GEM-4 (No-Action Alternative): ***Short- and Long-Term Increases in Sediment Load that Could Cause Substantial Increases in Channel Instability in Downstream Reaches***. Sediment transport analyses by Tetra Tech (2011) and sediment transport modeling by Reclamation (2011) indicate similar conditions associated with the No-Action Alternative and existing conditions. Sand inputs from Reach 2A would likely result in net deposition in the upper segment of Reach 2B and potentially down to the Mendota Pool, but Reach 3 would be subject to net erosion because Mendota Pool serves as a sediment trap for at least the sand and coarser portion of the sediment load passing through Reach 2B. Because sediment loads to Reach 3 and other downstream reaches would not substantially change, there would be a **less-than-significant** impact to downstream reaches.

Surface Water Quality

Impact SWQ-1 (No-Action Alternative): ***Construction-Related Effects on Water Quality.*** Under the No-Action Alternative, the Project would not be implemented and there would be no construction activities in the Project area. As a result, there would be **no impact** on water quality.

Impact SWQ-2 (No-Action Alternative): ***Long-Term Effects on Water Quality from Mobilization of Mendota Pool Sediments.*** Under the No-Action Alternative, the Project would not be implemented and operations of Mendota Dam would remain unmodified. Mendota Pool could expose potentially-contaminated sediments to Restoration Flows and downstream conveyance; however sediment transport to Reach 3 would be minimized by the obstruction of Mendota Dam. As a result, there would be a **less-than-significant** impact on water quality.

Impact SWQ-3 (No-Action Alternative): ***Long-Term Effects on Water Quality from Floodplain Inundation of Prior Agricultural Soils.*** Under the No-Action Alternative, the Project would not be implemented and the floodplain would not be widened. Compared to existing conditions, there would be no changes in long-term water quality in the Project area due to exposure of new floodplain area to river flow. As a result, there would be **no impact** on water quality.

Impact SWQ-4 (No-Action Alternative): ***Long-Term Effects on Water Quality from Agricultural Practices within the New Floodplain.*** Under the No-Action Alternative, the Project would not be implemented and the floodplain would not be widened. Compared to existing conditions, there would be no changes in long-term water quality in the Project area due to agricultural practices in new floodplain areas. As a result, there would be **no impact** on water quality.

Alternative A (Compact Bypass with Narrow Floodplain and South Canal)

Alternative A would entail construction of new Project facilities, including new levees to establish an approximately 3,000-foot-wide floodplain capable of safely conveying up to 4,500 cfs through the reach with 3 feet of freeboard. The Compact Bypass channel and levee system would be constructed to the north/east of the existing river channel to bypass Restoration Flows around Mendota Pool. Other key features include construction of a fish barrier below Mendota Dam, the Mendota Pool Dike (separating the San Joaquin River and Mendota Pool), and the South Canal and South Canal bifurcation structure, located near the upstream end of the reach, to deliver up to 2,500 cfs to Mendota Pool. The San Joaquin River control structure of the Chowchilla Bifurcation Structure would be removed, and the new South Canal bifurcation structure would be used to divert flood flows into the Chowchilla Bypass. The San Mateo Avenue crossing would be modified. No construction activities are proposed at or near Mendota Dam, which falls outside the Project boundary under Alternative A. Agricultural practices (e.g., annual crops, pasture, or floodplain-compatible permanent crops) would be allowed in the newly-created floodplain. Construction activity is expected to occur intermittently over an approximate 132-month timeframe.

Geomorphology

Impact GEM-1 (Alternative A): ***Substantially Altering the Existing Drainage Pattern, Including Alteration of the Course of the River, in a Manner which Would Result in Substantial On- or Off-Site Erosion***. Compared to the No-Action Alternative, the course of the river within the footprint of Alternative A upstream from the Compact Bypass channel would not be directly changed by the Project. The Compact Bypass channel would, however, direct flows to the north around Mendota Pool. The Compact Bypass channel would be designed as an unlined earthen channel, would be approximately 5,300 feet long with a total corridor width of approximately 950 feet. Vegetated revetment would be included along both channel banks within the portion of the bypass containing the grade control structures to provide additional protection against flanking. Revetment would likely consist of buried riprap covered with topsoil, erosion control fabric, and native woody vegetation (see Section 2.2.5). Revetment would prevent substantial on-site erosion; thus, this change would not result in substantial on- or off-site erosion.

Under this alternative, the channel would be re-connected to the floodplain within the levees, changing the overbank drainage patterns compared to the No-Action Alternative. This would provide a beneficial effect to channel geomorphology by limiting the in-channel energy and erosion potential at flows above bankfull and providing a sediment source to build and rejuvenate the floodplain.

In addition to its primary purpose of diverting flows into the South Canal, the South Canal bifurcation structure would also serve as a grade-control structure that would effectively fix the bed of the river at, and immediately upstream from, the structure, preventing channel downcutting in the upstream portion of Reach 2B that could result from downstream changes. Depending on the specific design, a local scour hole could develop on the downstream side of the structure that would cause a temporary increase in on-site erosion, particularly at high flows. However, protection measures would be incorporated into the structure to limit the adverse effects of this scour hole. Stone slope protection (riprap) would be provided on the upstream and downstream slopes of control structure embankments including some portions of the side slopes of the channel itself to prevent or minimize scouring. Riprap would be placed on bedding over geotextile fabric (see Section 2.2.5).

When comparing Alternative A to existing conditions, impacts to the existing drainage pattern would be similar to those described in the preceding paragraphs (i.e., the comparison of Alternative A to the No-Action Alternative). Because Project design would prevent substantial on-site erosion and because new structures would limit in-channel energy and erosion potential, this impact is considered to be **less than significant.**

Impact GEM-2 (Alternative A): ***Increased Aggradation or Degradation that Causes a Substantial Increase in Channel Instability within Reach 2B.*** Compared to the No-Action Alternative, construction of the new levees and the Compact Bypass channel would allow up to 4,500 cfs of Restoration Flows to be carried through the reach. As a result, there would be a substantial increase in the magnitude and duration of flows and an associated increase in both the amount of sediment delivered to the reach from upstream and the amount of sediment that actually moves through the reach.

Compared to existing conditions, Alternative A would result in similar impacts as described in the preceding paragraph (i.e., the comparison of Alternative A to the No-Action Alternative). The previously discussed sediment transport analyses by Tetra Tech (2011) and sediment-transport modeling by Reclamation (2011) indicate that Reach 2B is slightly aggradational under existing conditions, and this aggradational tendency would increase by a small amount (approximately 10 percent) for this alternative, in part due to reconnection of the channel with the floodplain and the associated effect of limiting in-channel energy and sediment transport capacity. Based on these studies, the aggradation does not appear to be sufficient to cause a substantial increase in channel instability; this impact would be **less than significant**.

Impact GEM-3 (Alternative A): ***Increases in Lateral Erosion that Could Damage Existing and/or Proposed Levees or Other Infrastructure within Reach 2B***. Compared to the No-Action Alternative, the duration of flows up to the existing capacity of Reach 2B would not change. However, with construction of the new levees and Compact Bypass channel under this alternative, flows up to 4,500 cfs would pass through the reach; thus, there would be more energy available to drive lateral erosion. To protect levees from erosion, a 300-foot buffer between the river channel and levees would be provided. If the buffer cannot be provided along river bends or at structures, erosion protection such as revetment, bioengineering, or other erosion protection techniques would be implemented to prevent or minimize erosion (see Section 2.2.4).

When comparing Alternative A to existing conditions, impacts would be similar to those described in the preceding paragraph (i.e., the comparison of Alternative A to the No-Action Alternative). Considering the historical lack of lateral erosion, even under the much higher flows during the pre-Friant Dam period and the likelihood that additional riparian vegetation that would tend to protect against bank erosion would establish along the reach, the inclusion of erosion protection offsets the potential for increases in lateral erosion. The impact on geomorphology would be **less than significant**.

Impact GEM-4 (Alternative A): ***Short- and Long-Term Increases in Sediment Load that Could Cause Substantial Increases in Channel Instability in Downstream Reaches***. Under Alternative A, Restoration Flows of up to 4,500 cfs would pass through Reach 2B and the Compact Bypass channel into Reach 3. Sediment transport analyses by Tetra Tech (2011) and sediment transport modeling by Reclamation (2011) indicates that this would cause a substantial increase in the sediment load to Reach 3, as compared to the No-Action Alternative, both due to the increase in flow conveyance capacity of Reach 2B and due to elimination of the buffering effect of Mendota Pool. Since the flows in Reaches 3 and 4A would be more frequently in the upper range of their capacities under Alternative A, the capacity of those reaches to transport the higher sediment supply would also increase. Estimates of the sediment transport balance in Reach 3 indicate that the reach would be in approximate sediment transport balance under this alternative; thus, there should not be substantial increases in downstream channel instability.

When comparing Alternative A to existing conditions, impacts would be similar to those described in the preceding paragraph (i.e., the comparison of Alternative A to the No-Action Alternative). The impact would be **less than significant**.

Surface Water Quality

Impact SWQ-1 (Alternative A): ***Construction-Related Effects on Water Quality.*** Compared to the No-Action Alternative, Alternative A would result in temporary adverse impacts to surface water quality due to the release of sediments and other contaminants during construction activities (without incorporation of appropriate best management practices or BMPs as mitigation described below). Construction activity is expected to occur intermittently over approximately 8.5 to 11 years. Construction activities, including grading, vegetation removal, excavation, trenching, and backfilling, have the potential to affect surface water quality, if not properly controlled. These activities could result in disturbed soils being temporarily exposed to the erosive forces of wind, rain, and stormwater runoff, which could result in the release of sediment into nearby water bodies, drainage ditches and the San Joaquin River. In addition to the release of sediment, contamination of stormwater runoff with typical chemicals used during construction such as fuels, oils, lead solder, solvents, and glues could occur through the daily use, transportation, and storage of these materials, if not properly controlled.

Flow in the San Joaquin River and operation of the existing Columbia Canal would be maintained during construction; therefore, construction of control structures in the river channel would require installation of removable cofferdams and temporary diversion of flows around the work area (see Construction Considerations in Section 2.2.4). Conveyance of sediment and other pollutants from construction areas to receiving waters could occur directly during in-water work or by direct overland flow.

When comparing Alternative A to existing conditions, impacts would be similar to those described in the preceding paragraphs (i.e., the comparison of Alternative A to the No-Action Alternative). This impact is considered to be **potentially significant.**

Mitigation Measure SWQ-1 (Alternative A): ***Development and Implementation of SWPPP.*** A SWPPP consistent with the Statewide NPDES Construction General Permit (Order No. 2009-0009-DWQ, as amended) will be developed and implemented. The SWPPP will detail the construction-phase erosion and sediment control BMPs and the housekeeping measures for control of contaminants other than sediment, as well as the treatment measures and BMPs to be implemented for control of pollutants once the Project has been constructed. Erosion control BMPs will include source control measures such as scheduling of construction activities with regard to the rainy season, wetting of dry and dusty surfaces to prevent fugitive dust emissions, preservation of existing vegetation, and effective soil cover (e.g., geotextiles, straw much, hydroseeding) for inactive areas and finished slopes to prevent sediments from being dislodged by wind, rain, or flowing water. Sediment control BMPs will include measures such as street sweeping transportation corridors, and installation of fiber rolls and sediment basins to capture and remove particles that have already been dislodged. The SWPPP will establish good housekeeping measures such as construction vehicle storage and maintenance, handling procedures for hazardous materials, and waste management BMPs. These BMPs include procedural and structural measures to prevent release of wastes and materials used at the site. BMPs associated with installation of removable cofferdams and temporary diversion of flows around the work area will be described. The SWPPP will also describe post-construction BMPs to be implemented for control of pollutants once the Project has been constructed.

Implementation of the SWPPP would avoid or mitigate runoff pollutants at the construction sites to the “maximum extent practicable.” (See also Chapter 13.0, “Hydrology – Groundwater,” which addresses impacts to groundwater and Chapter 19.0, “Public Health and Hazardous Materials,” which addresses impacts from release of hazardous materials during construction.) The impact would be **less than significant** after mitigation.

> **Implementation Action**: Project proponents and/or the construction contractor will prepare and implement an SWPPP consistent with requirements in the Statewide NPDES Construction General Permit. The SWPPP will set forth a BMP monitoring, maintenance, and reporting schedule and will identify the responsible entities during the construction and post-construction phases. Monitoring will include visual inspections of the BMPs, inspection for non-stormwater discharges, and visual inspection and/or sample collection of stormwater discharges. If

monitoring results indicate that the discharge is above the turbidity Numeric Action Level (NAL) or outside the range of the pH NAL, a construction site and run-on evaluation will be conducted to determine the source of the pollutant and corrective actions will be immediately implemented if necessary.

Location: Project areas with active construction or used by construction personnel, including access roads, staging and storage areas, borrow sites, and areas within the river channel and on adjacent uplands.

Effectiveness Criteria: Performance tracking will be based on successful compliance with the Statewide NPDES Construction General Permit.

Responsible Agency: Reclamation and the construction contractor.

Monitoring/Reporting Action: At a minimum, annual reports will be submitted to the SWRCB via the Storm Water Multiple Application and Report Tracking System.

Timing: The SWPPP will be developed prior to construction and will be implemented during construction.

Impact SWQ-2 (Alternative A): *Long-Term Effects on Water Quality from Mobilization of Mendota Pool Sediments.* Contaminants have been found in sediment accumulated in Mendota Pool above sediment quality thresholds including metals and persistent organic pollutants (i.e., arsenic, chromium, copper, nickel, 4,4'-DDD, and 4,4'-DDE). Concentrations of several constituents in elutriate derived from Mendota Pool sediments exceed water quality objectives (see Section 14.1.4). Contaminates were found to be uniformly distributed throughout Mendota Pool downstream of RM 205.5 with concentrations decreasing to insignificant levels above RM 207 (SJRRP 2012).

Compared to the No-Action Alternative, implementation of Alternative A could expose potentially-contaminated in-stream sediments to Restoration Flows and downstream conveyance. Alternative A includes construction of the Compact Bypass channel. The bypass channel would connect to Reach 2B approximately 0.9 mile upstream of Mendota Dam (approximately RM 205.5), bypass Mendota Pool to the north, and connect to Reach 3 approximately 0.6 mile downstream of Mendota Dam (approximately RM 204). The total elevation drop in the bypass channel would be approximately 12 feet (see Section 2.2.5). Grade-control structures would be included within the bypass channel to achieve the necessary elevation change between Reach 2B and Reach 3. The elevation of the upstream end of the bypass channel (which would be determined by the highest grade control structure in Alternative A) would influence erosion potential in the lower portion of Reach 2B. If the bypass channel is below existing grades, channel downcutting would occur. The increased erosion would be temporary as the channel adjusts to the new profile and Restoration Flow regime. Floodplain and channel grading could be used to establish a new equilibrium channel slope or to create more desirable sediment transport conditions to minimize erosion. Although there may be short-term erosion of potentially-contaminated sediments in areas upstream of the bypass channel (i.e., in the existing San

Joaquin River arm of Mendota Pool), the bypass would avoid the portions of Mendota Pool with the highest concentrations of contaminates and channel downcutting would be minimized by grade controls in the bypass channel. Transient increases in water quality contaminates would likely be diluted by increased flows to below water quality objectives.

Alternative A would not modify Mendota Dam or permanently lower Mendota Pool. Operations of Mendota Dam would be similar to operations under the No-Action Alternative (i.e., flashboards would be removed periodically for maintenance or flood flows).

When comparing Alternative A to existing conditions, impacts would be similar to those described in the preceding paragraphs (i.e., the comparison of Alternative A to the No-Action Alternative). The impact would be **less than significant**.

Impact SWQ-3 (Alternative A): *Long-Term Effects on Water Quality from Floodplain Inundation of Prior Agricultural Soils.* Compared to the No-Action Alternative, Restoration Flows under Alternative A could be exposed to soils containing metals, pesticides, and other priority pollutants on the new floodplain area. Portions of the existing levees would be removed and new levees would be constructed and set back from the river to form a narrow floodplain averaging approximately 3,000 feet wide. Land that is currently outside of the existing levees would be subject to periodic inundation by Restoration Flows. The area within the new Compact Bypass channel would also be subject to inundation.

Most of these areas are currently in agricultural production and have been for many years. Areas currently in agricultural production have been regularly irrigated and so potential surface contaminates that leach are likely to no longer be in the surface layer in even moderate concentrations. Other potential surface contaminants, such as legacy pesticides, bind tightly to soil organics, are relatively immobile in soil, and have a low tendency to leach.

Soil chemistry data are not available for areas currently in agricultural production; however, it is possible that the soils contain trace concentrations of herbicides and pesticides that are currently or were historically used in farming practices, including persistent organic pollutants such as DDT, its breakdown products (e.g., DDE), and dieldrin. Although DDT and dieldrin were banned for use in agriculture in the 1970s, they bind tightly to soils, are extremely persistent in the environment, highly toxic to many aquatic invertebrate species, and tend to biomagnify in the food chain. The reported half-life of DDT in soil is 2 to 15 years and the half-life of dieldrin in soil is 5 years. Newer pesticides are less likely to persist in soils or water. These persistent organic pollutants have been found in Mendota Pool sediments (SJRRP 2012) which suggests that they were historically used in the vicinity or have been influenced by inputs from the DMC. If persistent organic pollutants or other potential pollutants are present in soils on the floodplain or in the Compact Bypass channel, soil erosion could affect water quality in downstream reaches. Erosion protection such as revetment, bioengineering, or other erosion protection techniques would be implemented near levees and grade control structures to protect the Compact Bypass from excess erosion. Other engineered structures would also be protected (see Section 2.2.5). In addition, once a vegetative cover is established, erosion on the floodplain would be reduced. Soil erosion is most likely to occur during flood flows, which would also provide dilution.

When comparing Alternative A to existing conditions, impacts would be similar to those described in the preceding paragraphs (i.e., the comparison of Alternative A to the No-Action Alternative). The impact would be **potentially significant**.

Mitigation Measure SWQ-3 (Alternative A): ***Minimize Use of Pesticide and Herbicide Contaminated Soil.*** Refer to Mitigation Measure HAZ-4 (Alternative A). A similar mitigation measure would be used here. Construction activities in the Project area will be modified to minimize use of contaminated soil. Implementation of this mitigation measure would reduce this impact to a **less than significant** level.

> **Implementation Action:** The contractor will collect soil samples in conformance with EPA SW-846 methodology and analyze the samples for heavy metals and chlorinated pesticides and herbicides. The analytical results will be evaluated against EPA's Regional Screening Levels (2012), guidelines for freshwater disposal of dredge materials, aquatic toxicity screening levels, or other regulatory and literature guidance documents for aquatic toxicity. Alternatively, aquatic testing may be conducted on representative soil samples for this purpose. If the soil pesticide and herbicide conglomerate toxicity factors and/or toxicity testing shows unacceptable toxicity levels, that soil will not be used in the construction of Project levees and concentrated areas of contamination would be remediated in areas where the soil will come in direct contact with the San Joaquin River water.
>
> **Location:** Floodplain areas or areas used for borrow materials.
>
> **Effectiveness Criteria:** Effectiveness will be based on compliance with testing and risk assessment guidelines.
>
> **Responsible Agency:** Reclamation and the construction contractor.
>
> **Monitoring/Reporting Action:** Adequacy of the proposed construction practices will be confirmed with Reclamation managers and California State Lands Commission monitors.
>
> **Timing:** Prior to construction of Project levees or floodplain grading.

Impact SWQ-4 (Alternative A): ***Long-Term Effects on Water Quality from Agricultural Practices within the New Floodplain.*** Compared to the No-Action Alternative, Alternative A would increase the amount of direct runoff from agricultural land uses to Reach 2B. Between the main river channel banks and the proposed levees, agricultural practices (e.g., annual crops, pasture, or floodplain-compatible permanent crops) would occur.

The use of herbicides and pesticides are regulated by DPR. Requirements for the use of these materials, such as avoidance and minimization measures and BMPs, are printed on the manufacture's labels. Only certain herbicides or pesticides can be used near waterways or in areas that could be inundated and these compounds must be applied consistent with DPR regulations. If herbicides or pesticides are used on agricultural lands within the floodplain area, they would be applied by DPR licensed or certified applicators according to label requirements. Application would not occur when weather parameters exceed label specifications (for example, when wind exceeds specified speed) or when precipitation occurs or is forecasted with a specified period to prevent pesticides from entering the water through surface runoff. Applications would adhere to label directions for application rates.

Cattle could continue to have direct access to the river in some areas and would be a direct source of nutrients. The cattle may also damage riparian vegetation and expose soils to erosion. Fields in the new floodplain could be drained by ditches that convey agricultural return flows and runoff to the river. Flow in the ditches would contain nutrients and pesticides used in agricultural practices. There may be increased loadings of nutrients and agricultural chemicals to the San Joaquin River; however, agricultural practices would comply with the Irrigated Lands Regulatory Program, and increased flow rates would likely dilute these pollutants to below water quality objectives.

When comparing Alternative A to existing conditions, impacts would be similar to those described in the preceding paragraphs (i.e., the comparison of Alternative A to No-Action Alternative). Therefore, the impact would be **less than significant**.

Alternative B (Compact Bypass with Consensus-Based Floodplain and Bifurcation Structure), the Preferred Alternative

Alternative B would entail construction of new Project facilities, including new levees to establish an approximately 4,200-foot-wide floodplain capable of safely conveying up to 4,500 cfs through the reach with 3 feet of freeboard. The Compact Bypass channel and levee system would be constructed to the northeast of the existing river channel to bypass Restoration Flows around Mendota Pool. Other key features include construction of the Compact Bypass Bifurcation Structure, which would allow up to 2,500 cfs to be conveyed from Reach 2B into Mendota Pool, and construction of a fish passage structure for the Compact Bypass Control Structure. Flow would continue to enter at the upstream end of Reach 2B through the existing San Joaquin River control structure of the Chowchilla Bifurcation Structure. A fish passage facility would be added to the structure. The San Mateo Avenue crossing would be removed. No construction activities are proposed at or near Mendota Dam, which falls outside the Project boundary under Alternative B. The new floodplain would be selectively planted following construction with native vegetation and managed for non-native plant species. Construction activity is expected to occur intermittently over an approximate 157-month timeframe.

Geomorphology

Impact GEM-1 (Alternative B): ***Substantially Altering the Existing Drainage Pattern, Including Alteration of the Course of the River, in a Manner which Would Result in Substantial On- or Off-Site Erosion***. Compared to the No-Action Alternative, effects on the existing drainage pattern under Alternative B would be the same as those described for Alternative A. Refer to Impact GEM-1 (Alternative A). This impact would be **less than significant.**

Impact GEM-2 (Alternative B): ***Increased Aggradation or Degradation that Causes a Substantial Increase in Channel Instability within Reach 2B.*** Compared to the No-Action Alternative, construction of the new levees and the Compact Bypass channel would allow up to 4,500 cfs of Restoration Flows to be carried through the reach. As a result, there would be a substantial increase in the magnitude and duration of flows and an associated increase in both the amount of sediment delivered to the reach from upstream and the amount of sediment that actually moves through the reach. There would also be an increase in the amount of material removed from the Reach 2B channel by river flows because the Compact Bypass channel in Alternative B would be designed to prevent long-term undesirable bed erosion or deposition problems in Reach 2B and the adjacent Reaches 2A and 3, especially at structures. The Compact Bypass design in Alternative B includes fewer grade control structures than the other alternatives, which would initiate channel bed erosion in Reach 2B to remove sediment that has been deposited in the San Joaquin River arm of Mendota Pool. This channel bed erosion is anticipated to be up to 7 to 8 feet deep near the upstream end of the Compact Bypass and gradually decrease to zero erosion approximately 4 miles further upstream (RM 210). The channel bed erosion in Reach 2B would result in sediment deposition in the Reach 3 channel. The Reach 3 deposition is anticipated to be up to 7 feet thick near the downstream end of the bypass and gradually decrease to zero deposition approximately 1 mile downstream (RM 203). These changes in the bed profile are expected to occur over the first 6 to 15 years post-construction depending on flows. The amount of degradation in Reach 2B and resulting aggradation in Reach 3 would be controlled by the Compact Bypass bifurcation structure as well as grade control structures in the bypass channel.

Compared to existing conditions, Alternative B would result in similar impacts as described in the preceding paragraph (i.e., the comparison of Alternative B to the No-Action Alternative). The previously discussed sediment transport analyses by Tetra Tech (2011) and sediment-transport modeling by Reclamation (2011) indicate that Reach 2B is slightly aggradational under existing conditions, and this aggradational tendency would decrease and become erosional in portions of Reach 2B for this alternative, due to design intent of the Compact Bypass. The degradation would be controlled by the Compact Bypass bifurcation structure as well as grade control structures in the bypass channel and does not appear to be sufficient to cause a substantial increase in channel instability; this impact would be **less than significant**.

Impact GEM-3 (Alternative B): ***Increases in Lateral Erosion that Could Damage Existing and/or Proposed Levees or Other Infrastructure within Reach 2B.*** Compared to the No-Action Alternative, the duration of flows up to the existing capacity of Reach 2B would not change. However, with construction of the new levees and Compact Bypass channel under this alternative, flows up to 4,500 cfs would pass through the reach; thus, there would be more energy available to drive lateral erosion. The degradation in Reach 2B and aggradation in Reach 3 (discussed above in Impact GEM-2 (Alternative B)) could induce some bank erosion adjacent to these areas, but the Project design would include riparian vegetation, rock vanes, woody materials, or revetment to protect against bank erosion in susceptible areas. In addition, the neck of the first meander bend downstream from the Chowchilla Bifurcation Structure is only about one channel width wide (approximately 280 feet). Although this area has not eroded significantly during the period of available photography, the bend could cut off very rapidly if lateral erosion does occur at this location. This would not endanger the levees in the reach, but it would steepen the local channel gradient, which could cause bed lowering on the downstream side of the Chowchilla Bifurcation Structure. To protect levees from erosion, a 300-foot buffer between the river channel and levees would be provided. If the buffer cannot be provided along river bends or at structures, erosion protection such as revetment, bioengineering, or other erosion protection techniques would be implemented to prevent or minimize erosion (see Section 2.2.4).

When comparing Alternative B to existing conditions, impacts would be similar to those described in the preceding paragraph (i.e., the comparison of Alternative B to the No-Action Alternative). Considering the historical lack of lateral erosion, even under the much higher flows during the pre-Friant Dam period and the likelihood that additional riparian vegetation that would tend to protect against bank erosion would establish along the reach, the inclusion of erosion protection offsets the potential for increases in lateral erosion. The impact on geomorphology would be **less than significant**.

Impact GEM-4 (Alternative B): ***Short- and Long-Term Increases in Sediment Load that Could Cause Substantial Increases in Channel Instability in Downstream Reaches***. Under Alternative B, Restoration Flows of up to 4,500 cfs would pass through Reach 2B and the Compact Bypass channel into Reach 3. Sediment transport analyses by Tetra Tech (2011) and sediment transport modeling by Reclamation (2011) indicates that this would cause a substantial increase in the sediment load to Reach 3, as compared to the No-Action Alternative, both due to the increase in flow conveyance capacity of Reach 2B and due to elimination of the buffering effect of Mendota Pool. There would also be an increase in the amount of material removed from the Reach 2B channel by river flows because the Compact Bypass channel in Alternative B would be designed to prevent long-term undesirable bed erosion or deposition problems in Reach 2B and the adjacent Reaches 2A and 3, especially at structures (see discussion above in Impact GEM-2 (Alternative B)). Since the flows in Reaches 3 and 4A would be more frequently in the upper range of their capacities under Alternative B due to the increased capacity in Reach 2B, the capacity of those reaches to transport the higher sediment supply would also increase. Estimates of the sediment transport balance in Reach 3 indicate that the reach would range from being in approximate sediment transport balance to slightly aggradational in the short term and slightly degradational over the long term under this alternative; thus, there should not be substantial increases in downstream channel instability.

When comparing Alternative B to existing conditions, impacts would be similar to those described in the preceding paragraph (i.e., the comparison of Alternative B to the No-Action Alternative). The impact would be **less than significant**.

Surface Water Quality

Impact SWQ-1 (Alternative B): ***Construction-Related Effects on Water Quality.*** Construction-related effects on water quality under Alternative B would be similar to those described for Alternative A. Refer to SWQ-1 (Alternative A) for details. The primary difference under Alternative B is the longer construction duration of 9 to 13 years. This impact is considered to be a **potentially significant** impact.

Mitigation Measure SWQ-1 (Alternative B): ***Development and Implementation of SWPPP.*** Refer to Mitigation Measure SWQ-1 (Alternative A). The same measure would be used here. A SWPPP will be developed and implemented which details the construction-phase erosion and sediment control BMPs and the housekeeping measures for control of contaminants other than sediment, as well as the treatment measures and BMPs to be implemented for control of pollutants once the Project has been constructed . This impact would be **less than significant after mitigation**.

Impact SWQ-2 (Alternative B): ***Long-Term Effects on Water Quality from Mobilization of Mendota Pool Sediments.*** Contaminants have been found in sediment accumulated in Mendota Pool above sediment quality thresholds including metals and persistent organic pollutants (i.e., arsenic, chromium, copper, nickel, 4,4'-DDD, and 4,4'-DDE). Concentrations of several constituents in elutriate derived from Mendota Pool sediments exceed water quality objectives (see Section 14.1.4). Contaminates were found to be uniformly distributed throughout Mendota Pool downstream of RM 205.5 with concentrations decreasing to insignificant levels above RM 207 (SJRRP 2012).

Compared to the No-Action Alternative, implementation of Alternative B could expose potentially-contaminated in-stream sediments to Restoration Flows and downstream conveyance. Alternative B includes construction of the Compact Bypass channel. The bypass channel would connect to Reach 2B approximately 0.9 mile upstream of Mendota Dam (approximately RM 205.5), bypass Mendota Pool to the north, and connect to Reach 3 approximately 0.6 mile downstream of Mendota Dam (approximately RM 204). The total elevation drop in the bypass channel would range approximately from 2 to 7 feet (see Section 2.2.6). Grade-control structures would be included within the bypass channel to achieve the necessary elevation change between Reach 2B and Reach 3. The elevation of the upstream end of the bypass channel (which in Alternative B would be determined by the Compact Bypass river control structure) would influence erosion potential in the lower portion of Reach 2B. The bypass channel would be constructed below existing grades, and channel downcutting in Reach 2B would occur. The increased erosion would be temporary as the channel adjusts to the new profile and Restoration Flow regime. Floodplain and channel grading could be used to establish a new equilibrium channel slope or to create more desirable sediment transport conditions to minimize erosion. Although there may be short-term erosion of potentially-contaminated sediments in areas upstream of the bypass channel (i.e., in the existing San Joaquin River arm of Mendota Pool), the bypass would avoid the portions of Mendota Pool with the highest concentrations of contaminates and amount of channel downcutting would be controlled by the Compact Bypass river control structure and grade control structures in the bypass channel. Transient increases in water quality contaminates would likely be diluted by increased flows to below water quality objectives.

Alternative B would not modify Mendota Dam or permanently lower Mendota Pool. Operations of Mendota Dam would be similar to operations under the No-Action Alternative (i.e., flashboards would be removed periodically for maintenance or flood flows).

When comparing Alternative B to existing conditions, impacts would be similar to those described in the preceding paragraphs (i.e., the comparison of Alternative B to the No-Action Alternative). The impact would be **less than significant**.

Impact SWQ-3 (Alternative B): ***Long-Term Effects on Water Quality from Floodplain Inundation of Prior Agricultural Soils.*** Long-term effects on water quality of Restoration Flows within the new floodplain under Alternative B would be similar to those described for Alternative A. Refer to SWQ-3 (Alternative A) for details. The primary difference under Alternative B is that the larger floodplain area could encompass more farmland acreage. This impact would be **potentially significant**.

Mitigation Measure SWQ-3 (Alternative B): ***Minimize Use of Pesticide and Herbicide Contaminated Soil.*** Refer to Mitigation Measure SWQ-3 (Alternative A). The same measure would be used here. Construction activities in the Project area will be modified to minimize use of contaminated soil. Implementation of this mitigation measure would reduce this impact to a **less than significant** level.

Impact SWQ-4 (Alternative B): ***Long-Term Effects on Water Quality from Agricultural Practices within the New Floodplain.*** Similar to the effects described for Alternative A, agricultural practices would continue under Alternative B in the proposed floodplain between the main river channel banks and the proposed levees. There may be increased loadings of nutrients and agricultural chemicals to the San Joaquin River; however, agricultural practices would comply with the Irrigated Lands Regulatory Program, and increased flow rates would likely dilute these pollutants to below water quality objectives. Direct impacts of those practices on water quality in the San Joaquin River would be **less than significant**.

Alternative C (Fresno Slough Dam with Narrow Floodplain and Short Canal)

Alternative C would entail construction of new Project facilities, including new levees to establish an approximately 3,000-foot-wide floodplain capable of safely conveying up to 4,500 cfs through the reach with 3 feet of freeboard. A new dam would be constructed across Fresno Slough to contain Mendota Pool so that up to 4,500 cfs of Restoration Flows can be conveyed downstream through the existing river channel and across the existing Mendota Dam sill into Reach 3. A portion of river sediments that have accumulated behind Mendota Dam would be removed and disposed of appropriately. A new Short Canal with a control structure capable of delivering up to 2,500 cfs from the river in Reach 2B to Mendota Pool would be constructed near the new dam. Other key features include construction of fish passage facilities at Mendota Dam, a fish screen on the Short Canal to prevent juvenile fish from entering Mendota Pool, and a fish barrier located just north of Fresno Slough dam to prevent adult fish from migrating into Fresno Slough during Kings River flood releases. The Chowchilla Bifurcation Structure would continue to divert San Joaquin River flows into Chowchilla Bypass during flood operations. A fish passage facility would be added to the San Joaquin River control structure of the Chowchilla Bifurcation Structure to provide upstream fish passage. The San Mateo Avenue crossing would be modified. The new floodplain would be planted following construction with native vegetation and managed for non-native plant species. Construction activity is expected to occur intermittently over an approximate 133-month timeframe.

Geomorphology

Impact GEM-1 (Alternative C): *Substantially Altering the Existing Drainage Pattern, Including Alteration of the Course of the River, in a Manner which Would Result in Substantial On- or Off-Site Erosion*. Compared to the No-Action Alternative, the course of the river within the footprint of Alternative C would not be changed by the Project. The existing Mendota Dam would be modified to provide run-of-the-river conditions during Restoration Flows, which would lower water-surface elevations and steepen the effective channel gradient through the San Joaquin River arm of Mendota Pool, increasing erosion potential in this area. The concrete sill at the existing dam would, however, remain in-place, providing grade control for the upstream reach and limiting the amount of downcutting that could occur in the upstream channel. The Project would excavate portions of the former pool impoundment area (i.e., the San Joaquin arm of Mendota Pool) to establish a new equilibrium channel slope (see Section 2.2.7) minimizing the amount of sediments being washed downstream when Mendota Dam is lowered. Some additional channel erosion may occur as the channel adjusts to future flows, but this erosion is expected to be relatively minor. Sediment levels in the Fresno Slough arm of Mendota Pool are expected to be similar as the No-Action Alternative because the water surface elevations would be maintained at levels similar to No-Action conditions.

When comparing Alternative C to existing conditions, impacts would be similar to those described in the preceding paragraph (i.e., the comparison of Alternative C to No-Action Alternative). As a result, this impact would be **less than significant.**

Impact GEM-2 (Alternative C): *Increased Aggradation or Degradation that Causes a Substantial Increase in Channel Instability within Reach 2B.* Compared to the No-Action Alternative, there would be a substantial increase in the magnitude and duration of high flow events and an associated increase in both the amount of sediment delivered to the reach from upstream and the amount of sediment that actually moves through the reach. In contrast to No-Action Alternative, Alternative C is expected to have increased degradation in the lower portion of the reach. Channel bed degradation and associated increase in bank heights may also cause an increase in bank instability.

Mendota Dam would be modified to provide run-of-the-river conditions, which would lower water-surface elevations and steepen the effective channel gradient through the reach, increasing erosion potential in the San Joaquin River arm of Mendota Pool. However, the Project would excavate portions of the former pool impoundment area (i.e., the San Joaquin arm of Mendota Pool) to establish a new equilibrium channel slope (see Section 2.2.7) minimizing the amount of sediments being washed downstream when Mendota Dam is lowered. Some additional degradation may occur during Restoration

Flows as the upstream channel adjusts to the lowered base-level control resulting from modifications to Mendota Dam.

According to an assessment of the equilibrium channel slope for this alternative, if portions of the former pool impoundment area were not excavated, the bank heights under Alternative C would increase by an average of 3.5 feet in approximately 4.5 miles of the downstream end of Reach 2B, as compared to the No-Action Alternative. Potential channel bed degradation associated with Alternative C would not progress sufficiently far upstream to impact either the new San Mateo Avenue crossing or the Chowchilla Bifurcation Structure.

Although levees and infrastructure within the potential degradation zone could be affected by an increase in bank erosion where they are in close proximity to the channel, a new equilibrium channel slope would be established to minimize channel downcutting (see Section 2.2.7) and appropriate levee protection measures, such as revetment, would be included near proposed structures (see Section 2.2.4). These measures would minimize the risk of channel instability.

When comparing Alternative C to existing conditions, impacts would be similar to those described in the preceding paragraphs (i.e., the comparison of Alternative C to No-Action Alternative). This impact would be **less than significant**.

Impact GEM-3 (Alternative C): ***Increases in Lateral Erosion that Could Damage Existing and/or Proposed Levees or Other Infrastructure within Reach 2B***. Refer to Impact GEM-2 (Alternative C). The potential for increased bank erosion and bank height under this alternative could lead to increases in lateral erosion that could damage proposed levees and other infrastructure. However, the Project would incorporate erosion protection as described in GEM-3 (Alternative A). As a result, impacts on geomorphology would be **less than significant**.

Impact GEM-4 (Alternative C): ***Short- and Long-Term Increases in Sediment Load that Could Cause Substantial Increases in Channel Instability in Downstream Reaches***. Compared to the No-Action Alternative, Alternative C would increase flow capacity in Reach 2B and, as discussed under Alternatives A and B, the increase in Restoration Flows passing through Reach 2B (i.e., flows between the existing safe channel capacity and the design capacity of 4,500 cfs) would increase sediment loading to the downstream reaches. In addition, Mendota Pool serves as a sediment trap for at least the sand and coarser portion of the sediment load passing through the upstream part of Reach 2B under the No-Action Alternative. Under Alternative C, the flash boards currently used to close the bays at Mendota Dam and back up water would be removed to provide run-of-the-river conditions during Restoration Flows. The modifications to Mendota Dam that would increase the gradient through the San Joaquin River arm of Mendota Pool (e.g., removing the flash boards) would reduce the effectiveness of the sediment trap in Mendota Pool, and sediment that would otherwise have been stored in Mendota Pool would pass directly downstream into Reach 3 causing short-term increases in the downstream sediment load into Reach 3. Sediment from the Fresno Slough arm of

Mendota Pool that would have been trapped behind Mendota Dam under the No-Action Alternative would likely be trapped behind Fresno Slough Dam under Alternative C.

Under the No-Action Alternative, the flash boards at Mendota Dam would have been periodically removed to facilitate maintenance on the structure, during which time some of the sediment trapped in Mendota Pool would be re-entrained and carried downstream into Reach 3, limiting the long-term sediment trapping effects. As a result, substantial increases in the long-term sediment load to downstream reaches (i.e., Reach 3) would be limited under Alternative C, and actually would be closer to a desired condition in which there is continuous sediment continuity through Reach 2B.

When comparing Alternative C to existing conditions, impacts would be similar to those described in the preceding paragraphs (i.e., the comparison of Alternative C to No-Action Alternative). As a result, this impact would be **less than significant**.

Surface Water Quality

Impact SWQ-1 (Alternative C): ***Construction-Related Effects on Water Quality.*** Construction-related effects on water quality would be the same under Alternative C as those described for Alternative A. Refer to SWQ-1 (Alternative A) for details. The primary difference under Alternative C is the potentially shorter construction duration of 7.5 to 11 years. This impact is considered to be a **potentially-significant** impact.

Mitigation Measure SWQ-1 (Alternative C): ***Development and Implementation of SWPPP.*** Refer to Mitigation Measure SWQ-1 (Alternative A). The same measure would be used here. A SWPPP will be developed and implemented which details the construction-phase erosion and sediment control BMPs and the housekeeping measures for control of contaminants other than sediment, as well as the treatment measures and BMPs to be implemented for control of pollutants once the Project has been constructed. This impact would be **less than significant** after mitigation.

Impact SWQ-2 (Alternative C): ***Long-Term Effects on Water Quality from Mobilization of Mendota Pool Sediments.*** Compared to No-Action Alternative, Mendota Dam would be modified under Alternative C to provide run-of-the-river conditions during Restoration Flows, which would lower water-surface elevations, steepen the effective channel gradient through the San Joaquin River arm of Mendota Pool, and increase the erosion potential in this area. Concentrations of several constituents in elutriate derived from these sediments exceed water quality objectives. Lowering the water surface elevation behind Mendota Dam would expose potentially-contaminated in-stream sediments to Restoration Flows and downstream conveyance. The increased erosion would be temporary as the channel adjusts to the new profile and Restoration Flow regime. The Project would excavate portions of the former Pool impoundment area (i.e., the San Joaquin arm of Mendota Pool) to establish a new equilibrium channel slope to minimize the amount of sediments being washed downstream when Mendota Dam is lowered. Although there may be short-term erosion of potentially-contaminated sediments, increased flow rates would likely dilute potential pollutants to below water quality objectives.

When comparing Alternative C to existing conditions, impacts would be similar to those described in the preceding paragraph (i.e., the comparison of Alternative C to the No-Action Alternative). The impact would be **less than significant**.

Impact SWQ-3 (Alternative C): *Long-Term Effects on Water Quality from Floodplain Inundation of Prior Agricultural Soils.* Long-term effects on water quality of Restoration Flows within the new floodplain under Alternative C would be the same as those described for Alternative A. Refer to SWQ-3 (Alternative A) for details. The primary different is that Alternative C does not include the Compact Bypass. This impact would be **potentially significant**.

Mitigation Measure SWQ-3 (Alternative C): *Minimize Use of Pesticide and Herbicide Contaminated Soil.* Refer to Mitigation Measure SWQ-3 (Alternative A). The same measure would be used here. Construction activities in the Project area will be modified to minimize use of contaminated soil. Implementation of this mitigation measure would reduce this impact to a **less than significant** level.

Impact SWQ-4 (Alternative C): *Long-Term Effects on Water Quality from Agricultural Practices within the New Floodplain.* Similar to the No-Action Alternative and existing conditions, agricultural practices under Alternative C would remain outside of the floodplain levees and direct impacts of those practices on water quality in the San Joaquin River would be limited. There would be **no impact**.

Alternative D (Fresno Slough Dam with Wide Floodplain and North Canal)

Alternative D would entail construction of new Project facilities, including new levees to establish an approximately 4,200-foot-wide floodplain capable of safely conveying up to 4,500 cfs through the reach with 3 feet of freeboard. As with Alternative C, a new dam would be constructed across Fresno Slough to contain Mendota Pool so that up to 4,500 cfs of Restoration Flows can be conveyed downstream through the existing river channel and across the existing Mendota Dam into Reach 3. A portion of river sediments that have accumulated behind Mendota Dam would be removed and disposed of appropriately. A new North Canal and North Canal bifurcation structure, capable of delivering up to 2,500 cfs from the river in Reach 2B to Mendota Pool, would be constructed. Three potential locations have been identified for the North Canal bifurcation structure (RM 209.8, RM 213.4 and RM 214.2). The river control structure of the North Canal bifurcation structure would include fish passage facilities. Other key features include removal of the San Joaquin River control structure of the Chowchilla Bifurcation Structure, construction of fish passage facilities at Mendota Dam, a fish screen on the North Canal to prevent juvenile fish from entering Mendota Pool, and a fish barrier located just north of the Fresno Slough Dam to prevent adult fish from migrating into Fresno Slough during Kings River flood releases. The San Mateo Avenue crossing would be modified. Agricultural practices (e.g., annual crops, pasture, or floodplain-compatible permanent crops) would be allowed in the newly-created floodplain. Construction activity is expected to occur intermittently over an approximate 158-month timeframe.

Geomorphology

Impact GEM-1 (Alternative D): ***Substantially Altering the Existing Drainage Pattern, Including Alteration of the Course of the River, in a Manner which Would Result in Substantial On- or Off-Site Erosion***. Refer to Impact GEM-1 (Alternative A); the potential impact of the North Canal bifurcation structure would be essentially the same as the South Canal bifurcation structure. Refer also to Impact GEM-1 (Alternative C); the impact in the approximately 4.5-mile reach upstream from the existing Mendota Dam would be essentially the same. This impact would be **less than significant**.

Impact GEM-2 (Alternative D): ***Increased Aggradation or Degradation that Causes a Substantial Increase in Channel Instability within Reach 2B.*** Refer to Impact GEM-2 (Alternative C). Effects on the existing drainage pattern under Alternative D would be the same as those described for Alternative C. This impact would be **less than significant**.

Impact GEM-3 (Alternative D): ***Increases in Lateral Erosion that Could Damage Existing and/or Proposed Levees or Other Infrastructure within Reach 2B***. Refer to Impact GEM-3 (Alternative C). Effects on lateral erosion under Alternative D would be the same as those described for Alternative C. This impact would be **less than significant**.

Impact GEM-4 (Alternative D): ***Short- and Long-Term Increases in Sediment Load that Could Cause Substantial Increases in Channel Instability in Downstream Reaches***. Refer to Impact GEM-4 (Alternative C). Effects on short-and long-term increases in sediment load under Alternative D would be the same as those described for Alternative C. This impact would be **less than significant**.

Surface Water Quality

Impact SWQ-1 (Alternative D): ***Construction-Related Effects on Water Quality.*** Construction-related effects on water quality under Alternative D would be the same as those described for Alternative A. Refer to SWQ-1 (Alternative A) for details. The primary difference under Alternative D is the potentially longer construction duration of 8 to 13 years. This impact is considered to be **potentially significant**.

Mitigation Measure SWQ-1 (Alternative D): ***Development and Implementation of SWPPP.*** Refer to Mitigation Measure SWQ-1 (Alternative A). The same measure would be used here. A SWPPP will be developed and implemented which details the construction-phase erosion and sediment control BMPs and the housekeeping measures for control of contaminants other than sediment, as well as the treatment measures and BMPs to be implemented for control of pollutants once the Project has been constructed. This impact would be **less than significant** after mitigation.

Impact SWQ-2 (Alternative D): ***Long-Term Effects on Water Quality from Mobilization of Mendota Pool Sediments.*** Long-term effects on water quality of Mendota Dam modification under Alternative D would be the same as those described for Alternative C. Refer to SWQ-2 (Alternative C) for details. The impact would be **less than significant**.

Impact SWQ-3 (Alternative D): ***Long-Term Effects on Water Quality from Floodplain Inundation of Prior Agricultural Soils.*** Long-term effects on water quality of Restoration Flows within the new floodplain under Alternative D would be the same as those described for Alternative A. Refer to SWQ-3 (Alternative A) for details. The primary different is that Alternative C does not include the Compact Bypass. This impact would be **potentially significant**.

Mitigation Measure SWQ-3 (Alternative D): ***Minimize Use of Pesticide and Herbicide Contaminated Soil.*** Refer to Mitigation Measure SWQ-3 (Alternative A). The same measure would be used here. Construction activities in the Project area will be modified to minimize use of contaminated soil. Implementation of this mitigation measure would reduce this impact to a **less than significant** level.

Impact SWQ-4 (Alternative C): ***Long-Term Effects on Water Quality from Agricultural Practices within the New Floodplain.*** Long-term effects on water quality of agricultural practices within the new floodplain under Alternative D would be the same as those described for Alternative A. Refer to SWQ-4 (Alternative A) for details. The impact would be **less than significant**.

15.0 Hydrology - Wetlands and Aquatic Resources

This chapter describes the environmental and regulatory setting for wetlands and other non-wetland waters of the United States in the Project area, analyzes the environmental consequences associated with Project alternatives, and identifies wetland impacts and mitigation measures, as appropriate. For the purposes of this document, wetlands and other aquatic resources (e.g., streams, lakes, and ponds) are a subset of waters of the United States. Biological resources such as aquatic species (e.g., fish, invertebrates, vegetation) are addressed in the biological resource chapters (Chapters 5, 6 and 7).

15.1 Environmental Setting

During the past century, the aquatic resources of the San Joaquin River and the Project area have undergone substantial changes because of human related activities. Extensive wetland areas were drained or filled. Many introduced species have spread and contributed to elimination or marginalization of native species. The decline of wetlands and associated native species has become a matter of public concern.

15.1.1 Existing Conditions

Biological resources addressed in this section include wetlands and other non-wetland waters of the United States. Existing conditions are the baseline biological resource conditions at the time of the Notice of Preparation/Notice of Intent distribution in July 2009. The baseline condition of these biological resources was determined through review of scientific literature, existing data sources, and field wetland delineations. In the case of wetlands, field data were collected at later dates, after the start of Interim Flows. Therefore, the best available information to describe existing conditions was typically from the period after the start of Interim Flows. Interim Flows substantially amplified flows in the river and elevated ordinary high water marks (OHWM).[1]

15.1.2 Categories for Wetlands and Other Waters of the United States

Three categories of potential jurisdictional wetlands were identified in the Project area, as well as potential other waters of the United States. The three wetland categories were riparian wetland, wet meadow, and marsh. Table 15-1 summarizes the acreage of each category of potential jurisdictional wetland and other waters of the United States in the Project area. The California Department of Fish and Wildlife (DFW) considers riparian wetland, wet meadow, and marsh as sensitive natural communities due to their limited distribution in California (DFW 2009; Hickson 2009). These wetland habitat types are described below.

[1] The OHWM is defined as the upper boundary of the active river channel along the bank and by lack of vegetation below it.

Table 15-1.
Project Area Wetlands and Waters of the United States

Wetland and Non-Wetland Type	Area (acres)
Riparian Wetlands	181.3
Wet Meadows	54.5
Marshes	81.3
Non-Wetland Waters of the United States	473.3
Total Riparian, Wetlands, and Other Waters	790.4

Riparian Wetlands

There are two primary types of riparian wetlands in the Project area – riparian forest and riparian scrub. They are described and analyzed together because they typically co-occur.

Riparian forest consists of the Fremont cottonwood forest (*Populus fremontii* forest alliance) and Oregon ash groves (*Fraxinus latifolia* forest alliance), and these typically occur along levees, floodplain terraces, and in concave depressions. At higher elevation and better drained soils, Fremont cottonwood forest dominates and integrates with sandbar and black willow.

Riparian scrub usually occurs in disturbed habitats along ditches and levees. Riparian scrub vegetation grows 10 to 30 feet tall and is dominated by the following vegetation alliances: black willow thickets (*Salix gooddingii* woodland alliance), buttonwillow thickets (*Cephalanthus occidentalis* shrubland alliance), red willow thickets (*Salix laevigata* woodland alliance), arrow weed thickets (*Pluchea sericea* shrubland alliance), blue elderberry stands (*Sambucus nigra* shrubland alliance), California rose briar patches (*Rosa californica* shrubland alliance), sandbar willow scrub (*Salix exigua* shrubland alliance) and silver bush lupine scrub (*Lupinus albifrons* shrubland alliance). Black willow prevails at lower elevations near the bankfull elevation[2] in areas dominated by poorly drained soils and flat topography. Mixed marsh and wet meadow species often occur in the adjacent understory in the vicinity of the riparian wetlands.

Wet Meadows

Meadows are herbaceous communities dominated by mixtures of perennial grasses and forbs with other grass-like species, such as rushes (*Juncus* species) and sedges (*Carex* species). Some meadows in the Project area include scattered riparian shrubs and trees, but do not contain enough woody vegetation to be included in the riparian scrub or riparian woodland wetland categories. Wet meadows are often located adjacent to dry meadows and other upland areas that are higher above the groundwater table. They typically include flat or concave surface relief and occur in low-lying troughs and basins with poorly drained soils near the San Joaquin River or its tributaries. These site characteristics help maintain extended periods of soil saturation or flooding during the growing season. The vegetation alliances that occur in the wet meadow wetlands are yerba mansa meadows (*Anemopsis californica* herbaceous alliance), creeping rye grass

[2] The bankfull elevation occurs where the stream completely fills its channel at maximum capacity.

turfs (*Leymus triticoides* herbaceous alliance), salt grass flats (*Distichlis spicata* herbaceous alliance) and non-native annual grasslands.

Wet meadows occur throughout the Project area and are sometimes used for livestock grazing. They occur in swales, drainages, and on lower riparian terraces. These wetlands receive water from the high water table, overbank flooding and sheet drainage from excessive runoff during winter, spring, and early summer. Tarplant (*Centromadia pungens*), yerba mansa (*Anemopsis californica*), alkali heath (*Frankenia grandiflora*), salt grass (*Distichlis spicata*), and creeping wildrye (*Leymus triticoides*) often occur in wet meadows in the Project area. The higher quality wetlands of this type are located in the downstream portion of the reach, near Mendota Pool.

Marshes

The marsh wetlands in the Project area consist of mixed marsh vegetation alliances that are dominated by annual and perennial emergent vegetation with varying amounts of herbs and grass-like species. The vegetative cover is often very dense. In contrast to meadow communities, which have seasonally saturated soils, marsh communities have saturated or inundated soils throughout most of the year, except in some cases, during the dry months of late summer. River water retained by the Mendota Dam is the principal source of water for marshes in the Project area. The vegetation alliances that were observed in the marsh wetlands are California bulrush marsh (*Schoenoplectus californicus* herbaceous alliance), pale spike rush marshes (*Eleocharis macrostachya* herbaceous alliance) and cattail marshes (*Typha* species herbaceous alliance).

Potential Non-Wetland Other Waters of the United States

Additional aquatic elements in the Project area were identified as potential, jurisdictional non-wetland other waters of the United States based on the presence of defined bed and bank, drift lines and/or OHWM. These features (typically, the river channel between the OHWMs, areas of backed up water upstream of Mendota Dam, non-maintained irrigation and drainage ditches, and other small tributaries in the Project area) were mapped using a combination of field measurements and aerial photography. These waters of the United States lack hydrophytic vegetation[3] typically required to qualify as a wetland. Their limits are set by the OHWM. As directed by the Corps, the OHWM for potential other waters of the United States that are connected to the river is defined by the level on the bank that water reached during the highest Interim Flows in 2010. The limits of the OHWM for historical natural water features that are no longer connected to the river is indicated by physical characteristics such as a clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas (Corps 2005). Actively managed agricultural irrigation ditches, stock ponds and larger agricultural ponds were not considered other waters of the United States.

[3] Hydrophytic vegetation refers to plants that are adapted to live in saturated soil, flooded areas, or high groundwater conditions.

15.2 Regulatory Setting

This section presents the applicable Federal, State, and local laws and regulations associated with waters of the United States in the Project area.

The U.S. Army Corps of Engineers (Corps) and the U.S. Environmental Protection Agency (EPA) define wetlands as "those areas that are saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for the life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas." Waters of the United States, as defined in 33 Code of Federal Regulations (CFR) 328.3(a) and 40 CFR 230.3(s), include:

- All waters which are currently used, were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of the tide.
- All interstate waters including interstate wetlands.
- All other waters such as intrastate lakes, rivers, streams (including intermittent streams), mud flats, sand flats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural basins, the use, degradation, or destruction of which could affect interstate or foreign commerce including any such waters which are or could be used by interstate or foreign travelers for recreational or other purposes; or from which fish or shellfish are or could be taken and sold in interstate or foreign commerce; or which are used or could be used for industrial purposes by industries in interstate commerce.
- All impoundments of waters otherwise defined as waters of the United States under the definition.
- Tributaries of waters identified by the definition above.
- Territorial seas.
- Wetlands adjacent to waters (other than waters that are themselves wetlands) identified by the definition above.

Additional information about these natural resources can be found in the following documents:

- *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West Region* (Corps 2008a).
- *A Field Guide to the Identification of the Ordinary High Water Mark in the Arid West Region of the Western United States, a Delineation Manual* (Corps 2008b).

Waters that are themselves wetlands, while they may or may not be under Federal jurisdiction, typically are under State jurisdiction.

15.2.1 Federal

Federal laws and regulations pertaining to waters of the United States located in the Project area are summarized briefly below. More detail on regulatory compliance procedures can be found in Chapter 27, “Consultation, Coordination, and Compliance” and the *Technical Memorandum on Regulatory Compliance* (San Joaquin River Restoration Program [SJRRP] 2011) for Reach 2B.

Clean Water Act

The Clean Water Act (CWA) is the major Federal legislation governing the water quality aspects of the project. The objective of the act is “to restore and maintain the chemical, physical, and biological integrity of the nation’s waters.” The CWA establishes the basic structure for regulating discharge of pollutants into the waters of the United States and gives EPA the authority to implement pollution control programs, such as setting wastewater standards for industries. In certain states such as California, EPA has delegated some water quality regulatory authority to State agencies.

Under Section 404 of the CWA, the Corps regulates the disposal of dredged and fill materials into “waters of the United States.” These jurisdictional waters of the United States include intrastate lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds, and wetlands adjacent to any water of the United States (33 CFR Part 328). In areas subject to tidal influence, Section 404 jurisdiction extends to the high-tide line plus adjacent wetlands. Certain waters of the United States are considered “special aquatic sites” because they are generally recognized as having particular ecological value. Such sites include sanctuaries and refuges, mudflats, wetlands, vegetated shallows, coral reefs, and riffle and pool complexes. Special aquatic sites are defined by EPA and may be afforded additional consideration in the permit process for a project.

Projects that impact jurisdictional wetlands and non-wetland waters of the United States require a permit from the Corps. There are two types of permits: individual permits and general permits. Individual permits include standard permits and letters of permission. General permits include nationwide permits, regional general permits, and programmatic general permits. Nationwide permits are issued by the Corps for specific types of activities that have minimal individual or cumulative adverse environmental impacts. Individual permits are required for more complex projects that exceed the impact threshold for nationwide permits.

Section 303 of the CWA requires states to adopt water quality standards for surface waters. The three major components of water quality standards are designated users, water quality criteria, and anti-degradation policy. Section 303(d) of the CWA requires States and authorized Native American tribes to develop a list of water quality-impaired segments of waterways. The list includes waters that do not meet water quality standards necessary to support the beneficial uses of a waterway, even after point sources of pollution have had minimum required levels of pollution control technology installed. Only waters impaired by “pollutants” (e.g., clean sediments, nutrients such as nitrogen and phosphorus, pathogens, acids/bases, temperature, metals, cyanide, and synthetic organic chemicals), not those impaired by other types of “pollution” (e.g., altered flow, channel modification), are to be included on the list. Section 303(d) of the CWA also requires States to maintain a list of impaired water bodies so that a total maximum daily load (TMDL) of criteria pollutants can be established. A TMDL is a plan to restore the beneficial uses of a stream or to otherwise correct an impairment. It establishes the allowable pollutant loadings or other quantifiable parameters (e.g., pH, temperature) for a water body and thereby provides the basis for establishing water quality-based controls. The calculation for establishing TMDLs for each water body must include a margin of safety to ensure that the water body can be used for the purposes of State designation. Additionally, the calculation also must account for seasonal variation in water quality. The Central Valley Regional Water Quality Control Board (CVRWQCB) develops TMDLs for the San Joaquin River. The upstream end of Reach 2B is listed as impaired for invasive species and Mendota Pool is listed as impaired for mercury and selenium. The associated TMDLs are expected to be complete by 2021 (see Chapter 14.0, "Hydrology – Surface Water Resources and Water Quality.")

CWA Section 402 created the National Pollutant Discharge Elimination System permit program. This program covers point sources of pollution discharging into a surface water body. Stormwater discharges during Project construction would be subject to the permit requirements of the Construction General Permit, which requires the Project proponents to develop and implement a Stormwater Pollution Prevention Plan (see Chapter 14.0, "Hydrology – Surface Water Resources and Water Quality.")

Rivers and Harbors Act Section 10

Section 10 of the Rivers and Harbors Act (33 United States Code 401 et seq.) requires authorization from the Corps for construction of any structure over, in, or under, excavation of material from, or deposition of material into navigable waters of the United States. Reach 2B is considered a navigable section of the San Joaquin River (Corps 2014).

Executive Order 11990: Protection of Wetlands

This Executive Order (EO) directs Federal agencies to provide leadership and take action to minimize the destruction, loss, or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands in implementing civil works.

U.S. Coast Guard

The U.S. Coast Guard is responsible for approval of the location and plans of bridges and causeways constructed across navigable waters of the United States. In addition, the Coast Guard is responsible for approval of the location and plans of international bridges and the alteration of bridges found to be unreasonable obstructions to navigation. Project actions are not anticipated to affect the locations or plans of bridges or causeways constructed across navigable waters of the United States.

15.2.2 State of California

State laws and regulations pertaining to wetlands are discussed below.

Porter-Cologne Water Quality Control Act

Division 7 of the California Water Code, known as the Porter-Cologne Water Quality Control Act, regulates activities that affect water quality and authorizes the State Water Resources Control Board and the DFW to regulate wetland and non-wetland "Waters of the State" features, to allocate surface water rights, permit diversions, and to control the use of water throughout the State. Waters of the State are defined in California Water Code section13050, as amended, as "any surface water or groundwater, including saline waters, within the boundaries of the State."

California Fish and Game Code

Sections of the California Fish and Game Code provide environmental protections for fish and wildlife resources. Diversions, obstructions, or changes to the natural flow or bed, channel, or bank of any river, stream, or lake in California that supports wildlife resources are subject to regulation by DFW, pursuant to Fish and Game Code section 1602.

California State Lands Commission

The California State Lands Commission (CSLC) has exclusive jurisdiction over all ungranted tidelands and submerged lands owned by the State, and the beds of navigable rivers, sloughs, and lakes. A project cannot use these State lands unless a lease is first obtained from the CSLC.

California Harbors and Navigation Code

The California Harbors and Navigation Code details the jurisdictions of the California Department of Parks and Recreation, Division of Boating and Waterways , which focus development of public access to waterways, safety of vessels and boating facilities, and on-the-water safety. Coordination with the Division of Boating and Waterways regarding design standards for future boating facilities could be required for installing new or modifying existing boating facilities, such as boat ramps, docks, or marinas.

15.2.3 Regional and Local

Regional and local plans and policies pertaining to wetlands are discussed below. As required by State law, counties in the Project vicinity have developed their own general plans. At a minimum, these documents must address the topics of land use, transportation, housing, conservation, open space, noise, and safety. These documents serve as statements of county goals, policies, standards, and implementation programs for the physical development of a county, and include the *Fresno County General Plan Policy Document* (2000) and the *Madera County General Plan Policy Document* (1995).

Fresno County General Plan

The Fresno County General Plan Policy Document (Fresno County 2000) outlines several policies for wetlands and riparian areas.

- Policies OS-D.1 to OS-D.3 supports a no-net loss wetland policy for the county, required projects to mitigate for loss of wetlands functions and values, and requires that best management practices be used to reduce pollutants and siltation near wetlands.

- Policy OS-D.4 requires a riparian protection zone around natural watercourses with buffers of 100 feet in width as measured from the top of the bank of unvegetated channels and 50 feet in width as measured from the outer edge of the dripline of riparian vegetation.
- Policy OS-D.7 supports the management of wetland and riparian plant communities for passive recreation, groundwater recharge, nutrient storage, and wildlife habitats.

Madera County General Plan

The Madera County General Plan Policy Document (Madera County 1995) outlines several policies for wetlands and riparian areas.

- Policies 5.D.2 and 5.D.3 require that wetland loss be mitigated in both regulated and non-regulated wetlands through any combination of avoidance, minimization, or compensation and that projects be designed in such a manner that pollutants and siltation would not significantly adversely affect the value or function of wetlands.
- Policy 5.D.4 requires riparian protection zones around natural watercourses with buffers of 100 feet in width as measured from the top of bank of unvegetated channels and 50 feet in width as measured from the outer edge for the canopy of riparian vegetation.

15.3 Environmental Consequences and Mitigation Measures

15.3.1 Impact Assessment Methodology

In order to evaluate where wetlands and other aquatic resources could potentially occur in the Project area, records from the U.S. Geological Survey 7.5 minute quadrangle for Mendota Dam (quadrangle 381D) in the National Wetlands Inventory database, maintained by the U.S. Fish and Wildlife Service (USFWS) (USFWS 2009), and records from the surrounding eight quadrangles (Jamesan, Tranquillity, Coit Ranch, Firebaugh, Poso Farm, Firebaugh NE, Bonita Ranch and Gravelly Ford) were reviewed. In addition, the following literature and other data sources were reviewed to evaluate potential impacts to waters of the United States in the Project area:

- San Joaquin River Restoration Study Background Report (McBain and Trush 2002).
- National Wetlands Inventory Maps.
- Aerial photographs of the Project area and vicinity.
- U.S. Department of Agriculture soil surveys of Fresno and Madera Counties, California (Natural Resources Conservation Service [NRCS] 2015, Soil Conservation Service [SCS] 1971, SCS 1962).
- Standard biological references and field guides including the Jepson Manual (Hickman 1993).

Jurisdictional wetland delineation surveys were also performed in 2010 and 2011 in areas where access was granted from private landowners. Wetland delineations in the Project area were conducted in accordance with the methodology presented in the *Corps of Engineers Wetlands Delineation Manual* (Corps 1987) and the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West* (Corps 2008a). A full description of the methodology was provided in *Existing Environmental Conditions: Data Needs and Survey Approach* (SJRRP 2010). The extent of wetlands in areas where access was not granted was estimated based on field work on adjacent properties, contour maps and aerial photography.

Based on the presence of wetlands and other aquatic resources in the Project area, a methodology for impact evaluation for wetlands and other aquatic resources was developed. Waters of the United States identified in the Project area were overlaid with Project impact areas in a Geographic Information System platform to determine the types and extent of waters of the United States potentially affected by the Project.

Potential impacts of the Project on wetland resources were characterized by evaluating direct, indirect, temporary, and permanent impacts. Direct impacts include the removal or loss of wetlands within the footprint of ground disturbing actions. Indirect impacts result from changes to habitat that are incidental to project implementation such as altering the water supply to existing wetlands. Temporary impacts have a short duration, and wetlands would be expected to recover or be restored within 3 to 5 years after Project implementation. An example would be the temporary diversion of water flows to install infrastructure, followed by wetland re-establishment. A permanent impact would involve the long-term alteration of wetland habitats such as wetland filling, removal, or flooding or dewatering of an area. An example would be the lowering the normal water elevation adjacent to a marsh area which then forms an upland riparian terrace lacking hydrology for wetlands.

15.3.2 Significance Criteria

State California Environmental Quality Act (CEQA) Guidelines Appendix G and National Environmental Policy Act (NEPA) Council on Environmental Quality (CEQ) Regulations were used to determine the significance of wetland impacts. Impacts on wetlands were assessed by estimating the potential changes to the quantity and quality of wetland habitats expected to develop over time under the Project alternatives with the wetland habitats condition under the No-Action Alternative. A key assumption is that conditions predicted to result with implementation of each Project alternative would occur within 50 years of Project implementation.

Under NEPA CEQ Regulations, impacts must be evaluated in terms of their context and intensity. Significant impacts may be beneficial or adverse and are considered equally. An example of a significant beneficial impact would be the conversion of a cattail marsh habitat to a habitat with greater functions and values for less common or listed species (such as a yerba mansa meadow).

These factors have been considered when applying the State CEQA Guidelines, which state that the Project would result in a significant impact to wetland resources if it would have a substantial adverse effect on any wetland riparian habitat, other wetland habitat, or other waters identified in local or regional plans, policies, or regulations, or by the DFW or USFWS. Examples of such effects are listed below.

- Have a substantial adverse effect either directly or indirectly on federally protected (jurisdictional) wetlands as defined by Section 404 of the CWA (including, but not limited to, marsh, riparian wetlands, seasonal wetlands etc.) through removal, filing, hydrological interruption, or other means.
- Have the potential to degrade the quality of the environment, substantially reduce the habitat of listed or sensitive wetland plant species or threaten to eliminate a wetland plant community.
- Conflict with any local policies or ordinances protecting wetland resources, such as a wetland protection policy, wetland protection ordinance, adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or State habitat conservation plan.

15.3.3 Impacts and Mitigation Measures

This section provides an evaluation of the effects of the Project alternatives on jurisdictional wetlands. With respect to wetlands and other waters of the United States, the primary environmental impact issue and concern is the following:

1. Fill, Fragment, Isolate, Divert, or Substantially Alter Potentially Jurisdictional Wetlands and Other Waters during Construction.
2. Fill, Fragment, Isolate, Divert, or Substantially Alter Potentially Jurisdictional Wetlands or Other Waters during the Operations and Maintenance Phase.
3. Conflict with Provisions of Local or Regional Plans Regarding Conservation Lands.

See also Chapter 6.0, “Biological Resources – Vegetation,” for a discussion of impacts to riparian habitat and other sensitive vegetation communities and Chapter 7.0, “Biological Resources – Wildlife,” for a discussion of habitat conservation plans. Other wetland-related issues covered in the Program Environmental Impact Statement/Report (PEIS/R) are not covered here because they are programmatic in nature and/or are not relevant to the Project area.

No-Action Alternative

Under the No-Action Alternative, the Project would not be implemented and none of the Project features would be developed in Reach 2B of the San Joaquin River. However, other proposed actions under the SJRRP would be implemented, including habitat restoration, augmentation of river flows, and reintroduction of salmon. Without the Project in Reach 2B, however, these activities would not achieve the Settlement goals. The potential effects of the No-Action Alternative are described below. The analysis is a comparison to existing conditions, and no mitigation is required for No-Action.

Impact WET-1 (No-Action Alternative): ***Fill, Fragment, Isolate, Divert, or Substantially Alter Potentially Jurisdictional Wetlands and Other Waters during***

Construction. Under the No-Action Alternative, facilities and channels would not be constructed or modified in the Project area. Actions that could fill, fragment, isolate, divert, or substantially alter wetlands or other waters of the United States would not be implemented. There would be **no impact**.

Impact WET-2 (No-Action Alternative): *Fill, Fragment, Isolate, Divert, or Substantially Alter Potentially Jurisdictional Wetlands and Other Waters during the Operations and Maintenance Phase.* Under the No-Action Alternative, Restoration Flows in Reach 2B may recruit new vegetation along the wetted channel banks and riparian habitat would mature in areas upstream of San Mateo Avenue low flow/dip crossing. Wetland habitats supported by Mendota Pool would be maintained by the relatively stable water level held by Mendota Dam. Creation and enhancement of riparian habitat upstream of Mendota Pool would be a **beneficial** effect.

Impact WET-3 (No-Action Alternative): *Conflict with Provisions of Local or Regional Plans Regarding Conservation Lands.* The No-Action Alternative would not reduce the effectiveness of the Madera and Fresno counties' general plan conservation strategies, and attainment of conservation plan goals and objectives would not otherwise be prevented. The No-Action Alternative could result in beneficial effects on these plans because it would support attainment of goals or objectives related to enhancing wetlands and riparian areas along Reach 2B. This would be a **beneficial** effect.

Alternative A (Compact Bypass with Narrow Floodplain and South Canal)

Alternative A would include construction of Project facilities including a Compact Bypass channel, a new levee system encompassing the existing river channel in a narrow floodplain, and the South Canal. Other key features include construction of the Mendota Pool Dike (separating the San Joaquin River and Mendota Pool), a fish barrier below Mendota Dam, and the South Canal bifurcation structure and fish passage facility, modification of the San Mateo Avenue crossing, and the removal of the San Joaquin River control structure at the Chowchilla Bifurcation Structure. Construction activity is expected to occur intermittently over an approximate 132-month timeframe.

This alternative includes passive riparian habitat restoration and grazing or farming in the floodplain. It is assumed that over time wetland communities would develop within the main channel and that a dense riparian scrubland would develop along the main river channel banks. The Restoration Flows would be used to recruit new vegetation along the channel from the existing seed bank. Between the main river channel banks and the proposed levees, limited agricultural practices (e.g., annual crops, pasture, or floodplain-compatible permanent crops) would occur.

Impact WET-1 (Alternative A): *Fill, Fragment, Isolate, Divert, or Substantially Alter Potentially Jurisdictional Wetlands and Other Waters during Construction.* Construction activities have the potential to result, indirectly or directly, in adverse effects on jurisdictional waters of the United States and waters of the State, including wetlands. Compared to the No-Action Alternative, implementing Alternative A would result in channel modifications in Reach 2B to divert the river into the Compact Bypass channel for fish passage. This and other actions may involve dredging, grading, and recontouring within the OHWM of waters of the United States. As a result, dredged or fill materials would be discharged into waters of the United States, and permanent fill of Corps jurisdictional wetlands could occur.

Project actions to manage channel habitat may also result in temporary or permanent fill of waters of the United States, including wetlands. Channel habitat enhancement could involve dredging, grading, and recontouring to connect the existing channel to the Compact Bypass, which would result in discharge of fill material. In addition, some adjacent wetlands could be permanently filled or isolated by constructing control structures within the channel. These actions could result in loss of not only the filled wetlands, but any associated adjacent wetland habitat.

Construction of haul roads, staging areas, new levees, and other potential ancillary facilities could result in temporary or permanent fill of waters of the United States, including wetlands. Constructing and installing fish passage facilities, fish barriers, and new control structures, as well as modifying existing control structures and road crossings, and other Project actions, could also result in placement of fill into waters of the United States.

Although many of the Project actions could result in discharge of dredged or fill material into waters of the United States, including wetlands, most of these activities would not result in permanent loss of acreage, functions, or values of wetland habitats. New low-flow channel, side-channel, bypass channel, and floodplain habitat would be created and these and other modified areas of river reaches and bypasses would continue to convey water and support aquatic habitat.

Table 15-2 summarizes the impact acreage for Alternative A for each category of potentially jurisdictional wetlands and other waters in the Project area. These acreages represent the worst-case scenario where all existing floodplain areas are assumed to be impacted. “Infrastructure” generally refers to area permanently converted to structures, levees or roads. “Floodplain” refers to the floodplain of the San Joaquin River; the acreage impacted under this category may be disturbed up to 3 years following construction, but eventually would return to natural habitat or agriculture. “Borrow” refers to the maximum amount of habitat that could be disturbed to take fill materials for levees. Other impacts refer to construction staging areas, temporary access roads and other construction-related disturbances. Areas temporarily disturbed during construction would be restored to previous contours, if feasible, and then seeded with a native vegetation seed mixture to prevent soil erosion. Some areas, such as borrow areas, may not be feasible to restore previous contours, but these areas would be smoothed and seeded (see Section 2.2.4).

Table 15-2.
Wetlands and Waters of the United States Potentially Affected by Alternative A

Type	Maximum Impacted Area (acres)			
	Floodplain	Infrastructure	Borrow	Other
	(future habitat or agriculture)	(not future habitat)	(future habitat or agriculture)	
Riparian Wetlands	79.3	20.3	2.5	23.2
Wet Meadows	52.2	3.2	-	<0.02
Marshes	39.3	3.6	4.6	0.9
Non-Wetland Waters of the United States	351.6	50.5	9.9	31.9
Total Riparian, Wetlands, and Other Waters	522.4	77.7	17.0	56.0

Notes:
Floodplain = floodplain of the San Joaquin River (passive restoration and agricultural activities)
Infrastructure = structures, levees, or roads
Borrow = maximum amount disturbed to take fill materials for levees (reseeded)
Other = construction staging areas, temporary access roads, and other construction-related disturbances (reseeded)

The Project alternatives (including Alternative A) include specific conservation measures to avoid, minimize, or compensate for adverse effects on waters of the United States and waters of the State, including wetlands (as described in Table 2-8 of Chapter 2.0, "Description of Alternatives"), and these measures would be implemented as part of the Project alternative. Temporary impacts of the Project alternative would be minimized by implementation of conservation measures that require coordination with the Corps, identification and quantification of wetlands and waters of the United States/waters of the State, obtaining permits, and full compensation for any loss of wetlands and other waters of the United States/waters of the State. Implementing Conservation Measures WUS-1 and WUS-2 would ensure that loss and degradation of waters of the United States, and other wetland habitats, would be avoided and minimized during construction activities, to the extent feasible. Implementing Conservation Measures WUS-1 and WUS-2 would ensure that any wetland habitat or other waters of the United States that could not feasibly be avoided would be replaced, restored, or enhanced so that the Project would result in no net loss of aquatic acreage, functions, and values. Because conservation measures will be implemented as part of the Project, Alternative A would not have substantial effects on jurisdictional wetlands by construction of facilities or during other construction-related Project actions (e.g., habitat restoration).

When comparing Alternative A to existing conditions, impacts would be similar to those described in the preceding paragraphs (i.e., the comparison of Alternative A to No-Action Alternative). Impacts would be **less than significant**.

Impact WET-2 (Alternative A): ***Fill, Fragment, Isolate, Divert, or Substantially Alter Potentially Jurisdictional Wetlands and Other Waters during the Operations and Maintenance Phase.*** Compared to the No-Action Alternative, Alternative A would result in expanding the river's floodplain and increasing the flow conveyance capacity of the reach. These changes, in combination with Restoration Flows, have the potential to result in both adverse and beneficial effects on jurisdictional waters of the United States and waters of the State, including wetlands. The increase in flows could permanently inundate and thus eliminate some wetlands, but also expand or create additional areas of wetlands. Additionally, the reduction in normal water elevation in certain portions of Reach 2B caused by removal of the influence of Mendota Pool would drain and dewater some wetlands during some portions of the year, but would also expand or create additional areas of wetlands. After Project completion, in most instances, affected waters of the United States would be expected to have improved habitat functions as compared to No-Action conditions for several reasons: (1) fish habitat would be enhanced, (2) floodplain habitat would be expanded and enhanced, and (3) riparian habitat would be enhanced.

Long-term passive riparian habitat restoration of the San Joaquin River would improve native floodplain and in-channel habitats. Perennial base flows and seasonal high flows in the river would promote the establishment of riparian vegetation, wet meadows, and marshes and increase overall floodplain connectivity. Alternative A would restore river-floodplain connectivity and longitudinal connectivity of riparian vegetation near the channel and enhance landscape connectivity between the river corridor and adjacent sloughs or tributary channels.

When comparing Alternative A to existing conditions, effects would be similar to those described in the preceding paragraphs (i.e., the comparison of Alternative A to the No-Action Alternative). According to habitat restoration estimates, Alternative A could support up to 720 acres of wetlands and other waters within hydric soils in of the floodplain and bypass area. This is a 10 percent increase in acreage as compared to existing conditions. Wetland plant species can also become established in other areas of the floodplain, however without hydric soils these other areas would not qualify as jurisdictional wetlands.[4] Alternative A is expected to result in long-term **beneficial** effects to wetlands and other waters.

Impact WET-3 (Alternative A): *Conflict with Provisions of Local or Regional Plans Regarding Conservation Lands.* Compared to the No-Action Alternative, Alternative A would not conflict with the provisions of the Fresno and Madera counties' general plans regarding conservation lands. The Project would not result in long-term net loss of acreage, functions, or values of wetland habitats or riparian areas, interfere with the management of conserved lands, or eliminate opportunities for conservation actions. The Project is expected to result in a long-term increase in wetland and riparian habitats. These consequences of implementing the Project would benefit general plans that strive to conserve, restore, and enhance these habitats. The Project would enhance opportunities to implement conservation strategies and attain conservation goals by providing hydrologic conditions and floodplain areas necessary to restore wetlands.

[4] Growth of hydrophytic plants in areas without hydric soils is generally rare and usually only happens in transition zones between wetlands and uplands, transitional zones at and below the OHWM, and where fill has occurred recently.

When comparing Alternative A to existing conditions, impacts would be similar to those described in the preceding paragraph (i.e., the comparison of Alternative A to the No-Action Alternative) and would result in supporting county general plans. This is a **beneficial** effect.

Alternative B (Compact Bypass with Consensus-Based Floodplain and Bifurcation Structure), the Preferred Alternative

Alternative B would include construction of Project features including a Compact Bypass channel, a new levee system with a wide, consensus-based floodplain encompassing the river channel, and the Compact Bypass Bifurcation Structure with fish passage facility. Other key features include construction of a fish passage facility at the San Joaquin River control structure at the Chowchilla Bifurcation Structure, the re-route of Drive 10 ½ (across the Compact Bypass control structure), and removal of San Mateo Avenue crossing. Construction activity is expected to occur intermittently over an approximate 157-month timeframe.

This alternative includes a mixture of active and passive riparian and floodplain habitat restoration and compatible agricultural activities in the floodplain. Active restoration planting would occur along the low flow channel of the river and in riparian establishment areas to establish a riparian area and seed bank, and floodplain areas would be seeded with native plants. Natural riparian recruitment (passive restoration) would promote continual habitat succession, particularly in areas where sediment is deposited or vegetation is removed by natural processes. Plantings that are wetland species or borderline wetland species would be irrigated as necessary during the establishment period of 3 to 5 years. Maintenance, monitoring, and long-term management would be conducted following revegetation.

Impact WET-1 (Alternative B): ***Fill, Fragment, Isolate, Divert, or Substantially Alter Potentially Jurisdictional Wetlands and Other Waters during Construction.*** Refer to Impact WET-1 (Alternative A). Potential impacts of Alternative B would be similar to potential impacts of Alternative A, with the following exceptions. Construction of the Project under Alternative B would affect the acreages of wetlands and other waters shown in Table 15-3. Alternative B has less potentially impacted area for each of the major Project impact categories (i.e., floodplain, infrastructure, borrow, and other) compared to Alternative A. As described under Impact WET-1 (Alternative A), avoidance, minimization, and compensation for loss of wetlands and other waters would reduce adverse effects during construction. Impacts of Alternative B would be **less than significant**.

Table 15-3.
Wetlands and Waters of the United States Potentially Affected by Alternative B

Type	Maximum Impacted Area (acres)			
	Floodplain	Infrastructure	Borrow	Other
	(future habitat)	(not future habitat)	(future habitat or agriculture)	
Riparian Wetlands	79.0	24.5	3.4	3.9
Wet Meadows	51.3	-	-	-
Marshes	47.3	0.1	3.2	0.9
Non-Wetland Waters of the United States	339.3	22.0	5.0	13.3
Total Riparian, Wetlands, and Other Waters	517.0	46.5	11.6	18.1

Notes:
Floodplain = floodplain of the San Joaquin River (returns to habitat)
Infrastructure = structures, levees, or roads
Borrow = maximum amount disturbed to take fill materials for levees (reseeded)
Other = construction staging areas, temporary access roads, and other construction-related disturbances (reseeded)

Impact WET-2 (Alternative B): ***Fill, Fragment, Isolate, Divert, or Substantially Alter Potentially Jurisdictional Wetlands and Other Waters during the Operations and Maintenance Phase.*** Refer to Impact WET-2 (Alternative A). Potential impacts for Alternative B are similar to potential impacts of Alternative A, with the following exceptions. According to habitat restoration estimates, Alternative B could support up to 840 acres of wetlands and other waters within hydric soils in of the floodplain and bypass area. This is more than a 40 percent increase in acreage compared to existing conditions. Wetland plant species could also become established in other areas of the floodplain, however without hydric soils these other areas would not become jurisdictional wetlands. Alternative B also includes natural channel erosion in Reach 2B (in the approximate 4 miles upstream of the Compact Bypass) and some sediment deposition in Reach 3 (in the approximate 1 mile downstream of the Compact Bypass) in order to re-establish stable sediment transport. Downcutting and sedimentation may affect existing wetland vegetation adjacent to the river channel, but new wetland vegetation would be expected to establish in these areas. Alternative B is expected to have long-term **beneficial** effects to wetlands and other waters.

Impact WET-3 (Alternative B): ***Conflict with Provisions of Local or Regional Plans Regarding Conservation Lands.*** Refer to Impact WET-3 (Alternative A). Potential impacts for Alternative B would be the same as potential impacts of Alternative A. This would be a **beneficial** effect.

Alternative C (Fresno Slough Dam with Narrow Floodplain and Short Canal)

Alternative C would include construction of Project features including Fresno Slough Dam, a new levee system with a narrow floodplain encompassing the river channel, and the Short Canal. Other key features include construction of the Mendota Dam fish passage facility, the Fresno Slough fish barrier, the Short Canal control structure and fish screen, the Chowchilla Bifurcation Structure fish passage facility, modification of San Mateo Avenue crossing, and Main Canal and Helm Ditch relocations. Construction activity is expected to occur intermittently over an approximate 133-month timeframe.

Similar to Alternative B, Alternative C includes active riparian and floodplain habitat restoration. It is assumed that wetland communities would develop within the main channel, that a dense riparian scrubland would develop along the main river channel banks, and that bands of other habitat types (wetland, scrub, grassland, and forest) would develop at higher elevations along the channel corridor. The wetland, floodplain, and riparian areas would be planted following construction and then irrigated, monitored, maintained, and managed as necessary during the establishment period.

Impact WET-1 (Alternative C): ***Fill, Fragment, Isolate, Divert, or Substantially Alter Potentially Jurisdictional Wetlands and Other Waters during Construction.*** Refer to Impact WET-1 (Alternative A). Potential impacts of Alternative C would be similar to potential impacts of Alternative A. Construction of the Project would affect the acreages wetlands and other waters shown in Table 15-4. As described under Impact WET-1 (Alternative A), avoidance, minimization, and compensation for loss of wetlands and other waters would reduce adverse effects during construction. Impacts of Alternative C would be **less than significant**.

Table 15-4.
Wetlands and Waters of the United States Potentially Affected by Alternative C

Type	Maximum Impacted Area (acres)			
	Floodplain	Infrastructure	Borrow	Other
	(future habitat)	(not future habitat)	(future habitat or agriculture)	
Riparian Wetlands	112.1	13.8	11.7	18.6
Wet Meadows	52.2	-	-	<0.02
Marshes	48.1	6.4	3.0	7.2
Non-Wetland Waters of the United States	390.2	33.7	17.3	64.0
Total Riparian, Wetlands, and Other Waters	602.6	53.9	32.0	89.8

Notes:
Floodplain = floodplain of the San Joaquin River (active restoration)
Infrastructure = structures, levees, or roads
Borrow = maximum amount disturbed to take fill materials for levees (reseeded)
Other = construction staging areas, temporary access roads, and other construction-related disturbances (reseeded)

Impact WET-2 (Alternative C): ***Fill, Fragment, Isolate, Divert, or Substantially Alter Potentially Jurisdictional Wetlands and Other Waters during the Operations and Maintenance Phase.*** Refer to Impact WET-2 (Alternative A). Potential impacts for Alternative C are similar to potential impacts of Alternative A with the following exceptions. Alternative C includes active riparian and floodplain habitat restoration. Wetland, floodplain, and riparian areas would be planted following construction and then irrigated and managed as necessary during the establishment period. According to habitat restoration estimates, Alternative C could support up to 760 acres of wetlands and other waters within hydric soils in of the floodplain and Fresno Slough Dam area. This would be a slight increase in acreage compared to existing conditions. Wetland plant species can also become established in other areas of the floodplain, however without hydric soils these other areas would not qualify as jurisdictional wetlands. Alternative C is expected to have long-term **beneficial** effects to wetlands and other waters.

Impact WET-3 (Alternative C): ***Conflict with Provisions of Local or Regional Plans Regarding Conservation Lands.*** Refer to Impact WET-3 (Alternative A). Potential impacts for Alternative C would be the same as potential impacts of Alternative A. This would be a **beneficial** effect.

Alternative D (Fresno Slough Dam with Wide Floodplain and North Canal)

Alternative D would include construction of Project features including Fresno Slough Dam, a new levee system with a wide floodplain encompassing the river channel, and the North Canal. Other key features include construction of the Mendota Dam fish passage facility, the Fresno Slough fish barrier, the North Canal bifurcation structure and North Canal fish passage facility, removal of the San Joaquin River control structure at the Chowchilla Bifurcation Structure, removal of San Mateo Avenue crossing, and Main Canal and Helm Ditch relocations. Construction activity is expected to occur intermittently over an approximate 158-month timeframe.

Similar to Alternative A, Alternative D includes passive riparian habitat restoration and farming in the floodplain. It is assumed that over time wetland communities would develop within the main channel and that a dense riparian scrubland would develop along the main river channel banks. The Restoration Flows would be used to recruit new vegetation along the channel from the existing seed bank. Between the main river channel banks and the proposed levees, limited agricultural practices (e.g., annual crops, pasture, or floodplain-compatible permanent crops) would occur.

Impact WET-1 (Alternative D): ***Fill, Fragment, Isolate, Divert, or Substantially Alter Potentially Jurisdictional Wetlands and Other Waters during Construction.*** Refer to Impact WET-1 (Alternative A). Potential impacts of Alternative D are similar to potential impacts of Alternative A, with the following exception. Construction of the Project would affect the acreages of wetlands and other waters shown in Table 15-5. As described under Impact WET-1 (Alternative A), avoidance, minimization, and compensation for loss of wetlands and waters would reduce the potential for adverse effects during construction. Impacts of Alternative D would be **less than significant**.

Table 15-5.
Wetlands and Waters of the United States Potentially Affected by Alternative D

Type	Maximum Impacted Area (acres)			
	Floodplain	**Infrastructure**	**Borrow**	**Other**
	(future habitat or agriculture)	**(not future habitat)**	**(future habitat or agriculture)**	
Riparian Wetlands	116.4	16.4	4.3	15.9
Wet Meadows	51.9	0.3	-	<0.02
Marshes	48.1	4.9	3.0	8.1
Non-Wetland Waters of the United States	376.2	65.5	6.0	58.2
Total Riparian, Wetlands, and Other Waters	592.7	87.1	13.3	82.2

Notes:
Floodplain = floodplain of the San Joaquin River (passive restoration and agricultural activities)
Infrastructure = structures, levees, or roads
Borrow = maximum amount disturbed to take fill materials for levees (reseeded)
Other = construction staging areas, temporary access roads, and other construction-related disturbances (reseeded)

Impact WET-2 (Alternative D): ***Fill, Fragment, Isolate, Divert, or Substantially Alter Potentially Jurisdictional Wetlands and Other Waters during the Operations and Maintenance Phase.*** Refer to Impact WET-2 (Alternative A). Potential impacts for Alternative D are similar to potential impacts of Alternative A. Alternative D includes passive riparian habitat restoration and farming in the floodplain. Restoration Flows would be used to recruit new vegetation along the channel from the existing seed bank. Between the main river channel banks and the proposed levees, agricultural practices (e.g., annual crops, pasture, or floodplain-compatible permanent crops) would occur. According to habitat restoration estimates, Alternative D could support up to 880 acres of wetlands and other waters within hydric soils in of the floodplain and Fresno Slough Dam area. This is more than a 15 percent increase in acreage compared to existing conditions. Wetland plant species can also become established in other areas of the floodplain, however without hydric soils these other areas would not qualify as jurisdictional wetlands. Alternative D is expected to result in long-term **beneficial** effects to wetlands and other waters.

Impact WET-3 (Alternative D): ***Conflict with Provisions of Local or Regional Plans Regarding Conservation Lands.*** Refer to Impact WET-3 (Alternative A). Potential impacts for Alternative D would be the same as potential impacts of Alternative A. This would be a **beneficial** effect.

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16.0 Land Use Planning and Agricultural Resources

This chapter evaluates the potential land use and related agricultural impacts anticipated with implementation of the Project, including effects on agricultural resources due to farmland being removed from production. The analysis covers both short-term effects during construction and long-term effects resulting from implementation of restoration actions and operation of new Project facilities.

16.1 Environmental Setting

The agricultural and land use setting describes current land uses and ownership patterns in the Project area, which covers portions of Fresno and Madera counties in California. The predominant land use in the Project area is agriculture. Accordingly, the focus of this section is on agriculture, including cropping patterns, farmland designations as developed by the California Department of Conservation (DOC), and lands under Williamson Act contracts. Information is also provided on current land use and general plan designations. Collectively, this information provides context to the analysis of agricultural and land use impacts presented in Section 16.2. The data used to characterize existing land uses conditions in the Project area come from a variety of State and local sources as cited throughout the text.

16.1.1 Land Ownership

Land ownership in the Project area has been classified into three broad categories: public, private, and public trust (see Figure 16-1 and Table 16-1). Most of the land in the Project area (5,235 acres, or about 89 percent the Project area) is held in private ownership. The remaining land is either administered by various public agencies (377 acres, 6.4 percent) or is public trust land administered by the California State Lands Commission (CSLC) (191 acres, 3.2 percent). Public lands under the jurisdiction of the CSLC include both fee lands owned by the State and an easement interest in lands which are held in public trust.

As general background, the State of California acquired sovereign ownership of all tidelands and submerged lands and the beds of navigable waterways upon its admission to the United States in 1850. On navigable non-tidal waterways, such as the San Joaquin River, the State, acting by and through CSLC, holds fee ownership of the bed of the river landward to the ordinary low water mark and a public trust easement landward to the ordinary high water mark, except where there has been fill or artificial accretions or the boundary has been fixed by agreement or court decision. Such boundaries may not be readily apparent from present day site inspections. Whereas fee title in the bed of the river between the low water and high water marks is commonly held in private ownership, it remains subject to the public trust and the jurisdiction of CSLC. Private parties may not use the public trust easement area exclusively and uses within the easement area must be consistent with common law public trust uses including commerce, navigation, fisheries, recreation, scientific study and the preservation of open space.

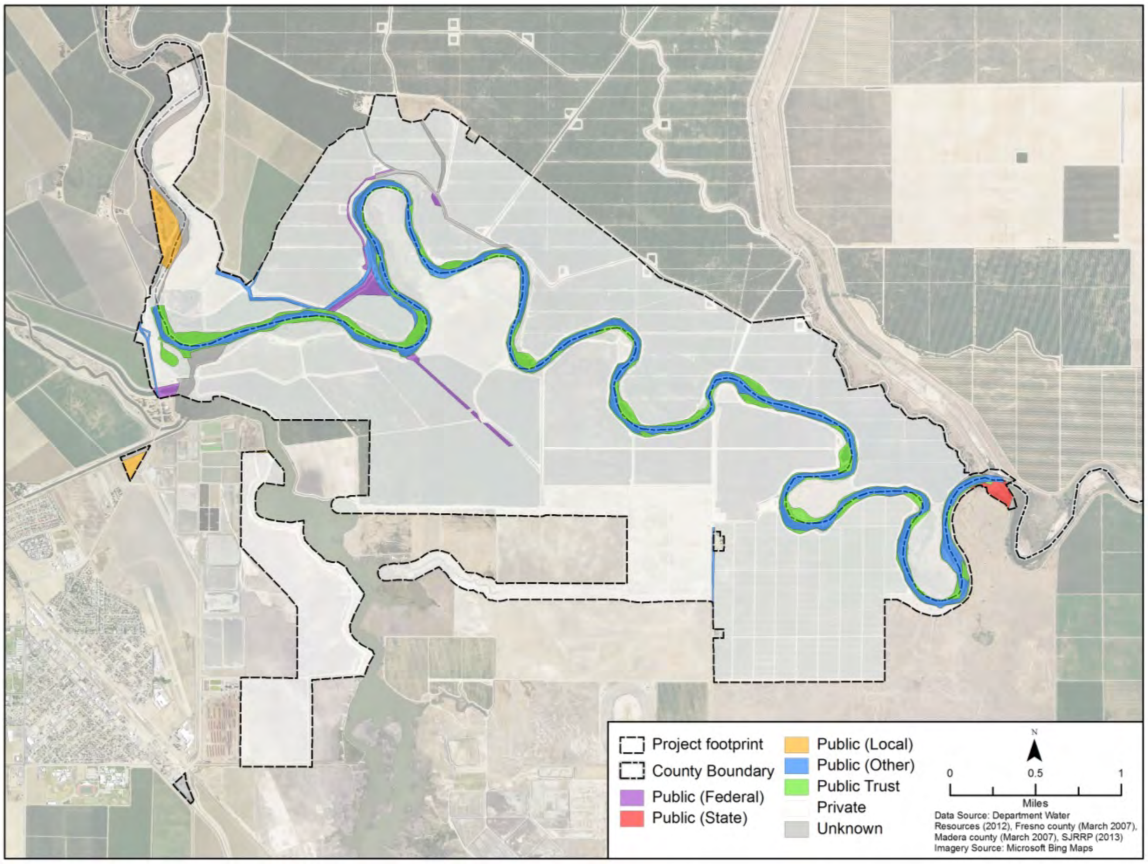

Figure 16-1.
Land Ownership in the Project Area

Table 16-1.
Land Ownership

Ownership	Acres	Percent (%)
Public	377	6.4
Federal	33	0.6
State	10	0.2
Local	37	0.6
Other	297	5.0
Private	5,235	88.8
Public Trust	191	3.2
Unknown	91	1.5
Total	**5,894**	**100.0**

Source: SJRRP 2011a, updated for this document

The extent of the CSLC's jurisdiction within the Project area is depicted on the Administrative Map for Reach 2B, which were developed at Reclamation's request in connection with the Project (CSLC 2011). A Record of Survey was filed for the San Joaquin River Administrative Map Reach 2B in both the Fresno and Madera County Recorder's Offices, respectively.

16.1.2 Land Use

Generally, the Project area is rural with most of the land along the river in agricultural production. For this analysis, land uses in the Project area have been classified into four general land use categories: (1) agricultural, (2) open space and undeveloped, (3) urban, and (4) water.[1] As shown in Figure 16-2 and Table 16-2, land use in Reach 2B is predominantly agricultural (4,227 acres, or 72 percent of the Project area) followed by open space and undeveloped land (1,242 acres, 21 percent), water (360 acres, 6.1 percent), and urban (14 acres, 0.2 percent). Additional information on cropping patterns is presented in Section 16.1.3. Although the extent of urban uses in the Project area is limited, the city of Mendota is located just west of the downstream portion of the Project area and several public roadways, including Bass Avenue and San Mateo Avenue travel through the area. Population in the city of Mendota was 11,167 in 2012 (California Department of Finance 2012).

16.1.3 Agricultural Production

The Project area is located within the San Joaquin Valley, a highly productive agricultural region in California. The region produces a wide variety of agricultural products, including, but not limited to, field crops, fruits, seed crops, tree nuts, and vegetables. The value of agricultural production in the region is substantial; refer to Chapter 21.0, "Socioeconomics and Economics" for more information on agricultural production values.

Cropping Patterns

Agriculture is the primary land use in the Project area and represents a key industry in the local and regional economy. Information on local cropping patterns was compiled for the Project area based on site surveys, California Department of Water Resources (DWR) land use data, and interviews with local landowners. Local agricultural production was classified into eight crop categories: alfalfa, almonds, cotton, grapes, grazing, other row crop, palms, and pistachios; vacant agricultural land was also identified. Existing cropping patterns in the Project area are presented in Figure 16-3 and Table 16-3.

Almonds are the largest single crop grown in the Project area, accounting for 45 percent of total agricultural acreage. The production of grapes (14 percent), other row crops (15 percent), and pistachios (12 percent) also represent important crops grown in the Project area. Approximately 10 percent of agricultural land in the Project area was not in active

[1] The land use data contain multiple categories that were aggregated as follows: Agricultural (citrus and subtropical; deciduous fruits and nuts; field crops; grain and hay crops; pasture; semi-agricultural and incidental to agriculture; truck, nursery and berry crops; and vineyards); Open Space and Undeveloped (idle, native vegetation, riparian vegetation, and vacant); Urban (industrial and urban); and Water (water surface). Some lands within the Project area were not surveyed with respect to current land use.

production. Based on cropping patterns, it is evident that local growers predominantly produce relatively higher-value permanent crops, namely nut crops.

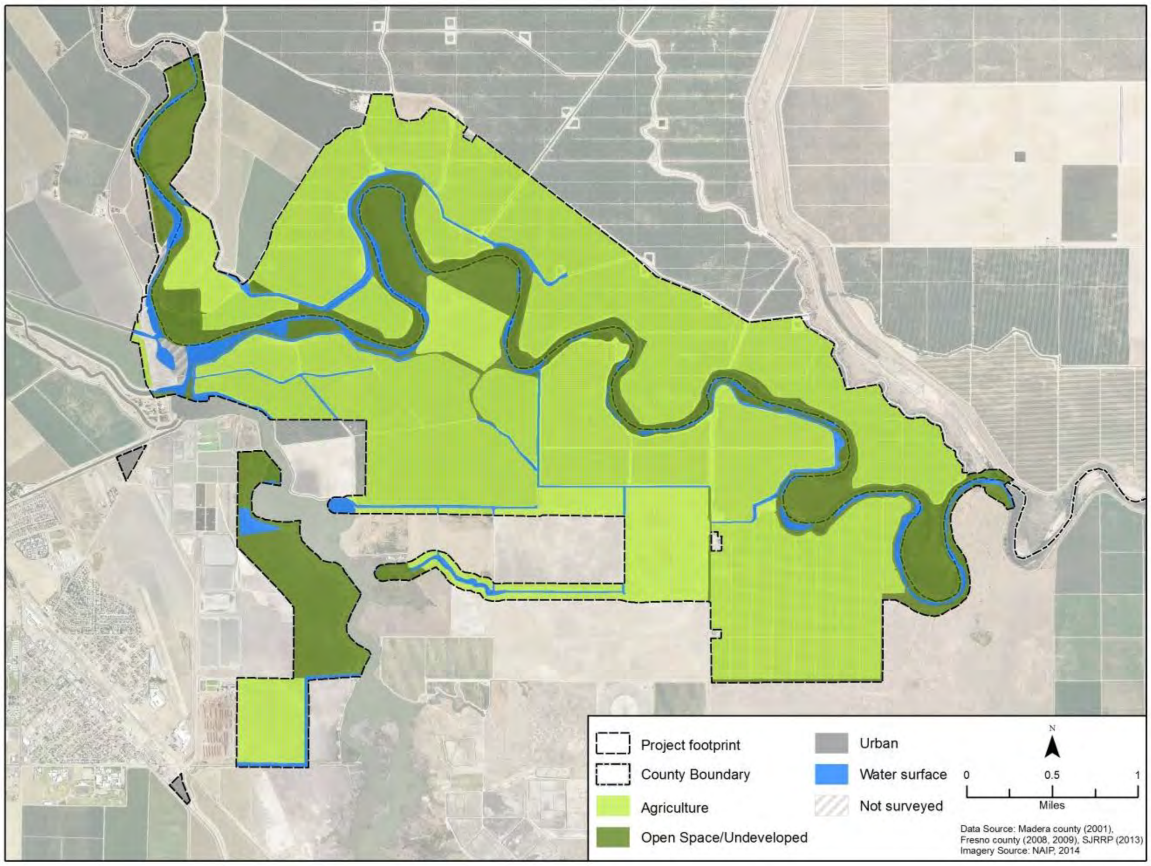

Figure 16-2.
Existing Land Use in the Project Area

Table 16-2.
Existing Land Use

Land Use	Acres	Percent (%)
Agriculture	4,227	71.7
Open Space / Undeveloped	1,242	21.1
Urban	14	0.2
Water	360	6.1
Not Surveyed	51	0.9
Total	**5,894**	**100.0**

Source: SJRRP 2012a,updated for this document

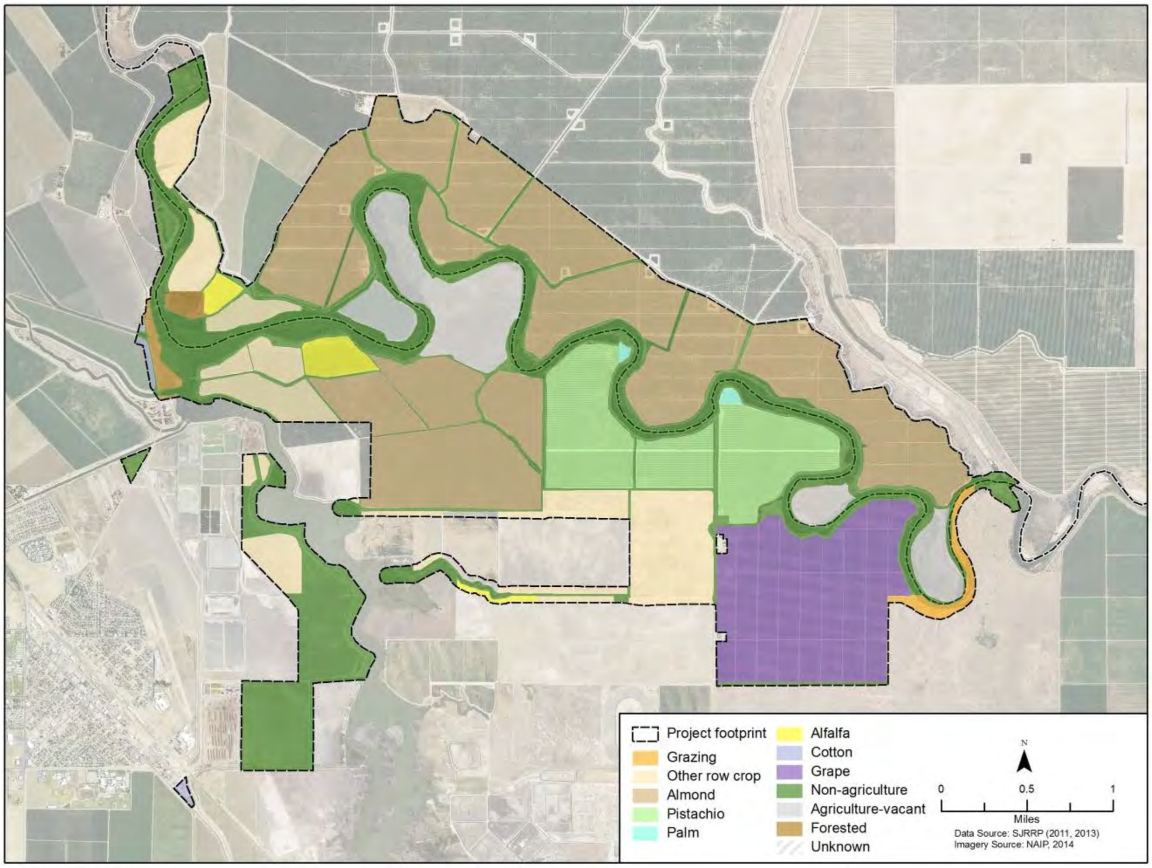

Figure 16-3.
Cropping Patterns in the Project Area

Table 16-3.
Cropping Patterns

Crop Type	Acres	Percent (%)
Alfalfa	80	1.8
Almonds	1,969	45.3
Cotton	15	0.3
Grapes	623	14.3
Grazing	42	1.0
Other row crop	655	15.1
Palm	10	0.2
Pistachios	519	11.9
Agriculture-Vacant	431	9.9
Total	**4,344**	**100.0**

Source: SJRRP 2012a updated for this document

Farmland Designations

The DOC, as part of its Farmland Mapping and Monitoring Program (FMMP), classifies land across the State into a range of agricultural land use categories based on technical soil ratings and current land use. This information is used to develop "Important Farmland" maps and track agricultural trends in the State. Below is a description of the FMMP mapping categories, which are defined, in part, by information from the U.S. Department of Agriculture. For more information on the FMMP, refer to Section 16.2.2.

- **Prime Farmland:** The best combination of physical and chemical features able to sustain long-term agricultural production.
- **Farmland of Statewide Importance:** Similar to Prime but with minor shortcomings such as greater slopes or less ability to store soil moisture.
- **Unique Farmland:** Farmland of lesser quality soils used for production of the State's leading agricultural crops.
- **Farmland of Local Importance:** Land of importance to the local agricultural economy as determined by each county's board of supervisors or local advisory committee.
- **Grazing Land:** Land with existing vegetation suited for livestock grazing.
- **Urban and Built-up Land:** Land occupied by structures used for residential, industrial, commercial, institutional, transportation yards, cemeteries, airports, golf courses, landfills, water or sewer treatment, or other developed purposes.
- **Other Land:** Land not included in any other mapping category. Often including low-density rural developments with brush, timber, or wetlands that are not suitable for livestock. This category includes strip mines, borrow pits, small bodies of water, and vacant and nonagricultural land surrounded on all sides by urban development.
- **Water:** Perennial bodies of water that are 40 acres or larger.

Figure 16-4 and Table 16-4 present the distribution of Important Farmland categories across the Project area. Most of the land in Reach 2B is considered designated Farmland[2] (about 76 percent of the Project area). Approximately 3,422 acres (58 percent) is considered Prime Farmland; 802 acres (14 percent) is Farmland of Statewide Importance; and 190 acres (3.2 percent) is Unique Farmland. In addition, Farmland of Local Importance accounts for approximately 565 acres (or 9.6 percent) in the Project area.

[2] Land considered "designated Farmland" consists of three farmland categories: Prime Farmland, Farmland of Statewide Importance, and Unique Farmland.

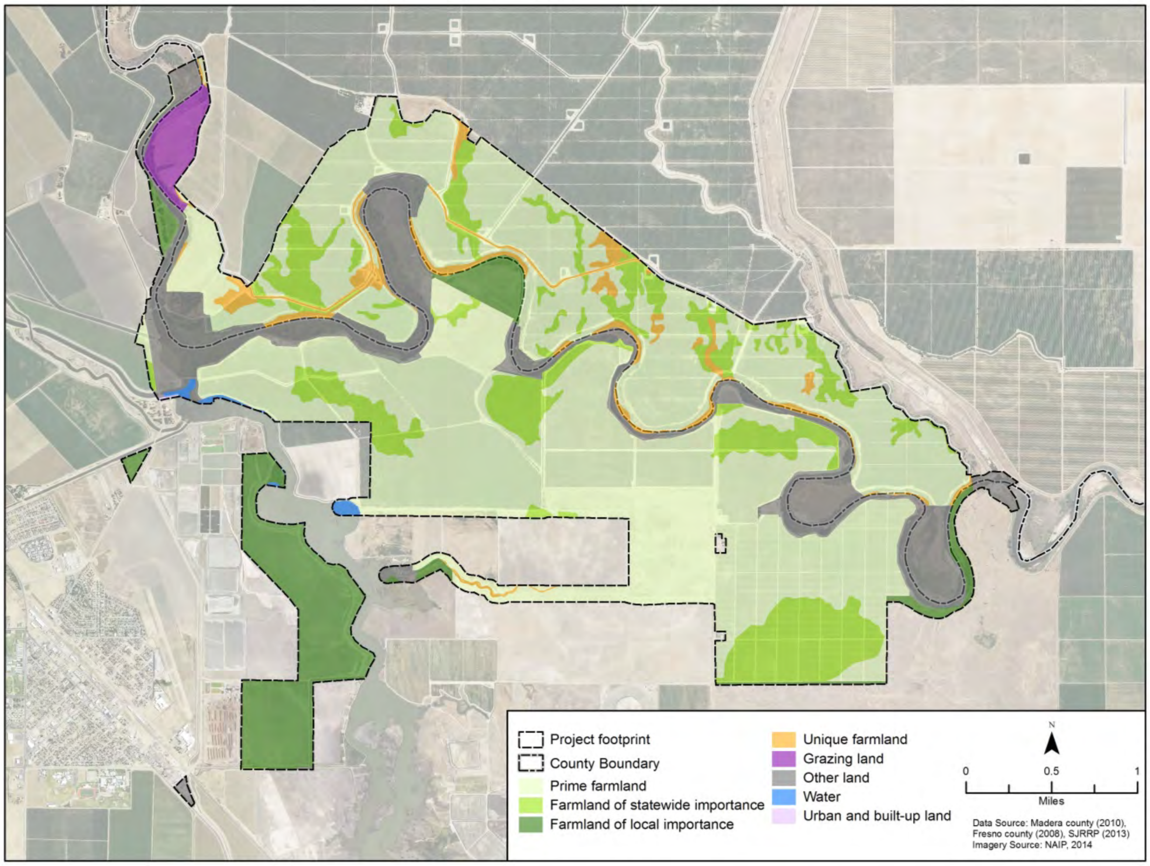

Figure 16-4.
Important Farmland in the Project Area

Table 16-4.
Important Farmland

Farmland Category	Acres	Percent (%)
Prime Farmland	3,422	58.1
Farmland of Statewide Importance	802	13.6
Unique Farmland	190	3.2
Farmland of Local Importance	565	9.6
Grazing Land	86	1.5
Urban and Built-Up Land	1	0.0
Other Land	807	13.7
Water	20	0.3
Total	**5,894**	**100.0**

Source: DOC 2010a

Williamson Act

Some agricultural lands in California are protected under the California Land Conservation Act, commonly called the Williamson Act. (For more information on the Williamson Act, refer to Section 16.2.2.) Across California, approximately 15 million acres were enrolled in Williamson Act contracts in 2009 (DOC 2010b). At the local level, much of the farmland in Fresno and Madera counties is under Williamson Act contracts. Specifically, over 2.0 million acres were enrolled in Williamson Act contracts in the two-county region in 2009, which represent nearly 14 percent of the statewide total. Similarly, agricultural land in the Project area also tends to be covered under the Williamson Act. As shown in Figure 16-5 and Table 16-5, approximately 76 percent of lands (4,508 acres) within the Project area are under Williamson Act contract.

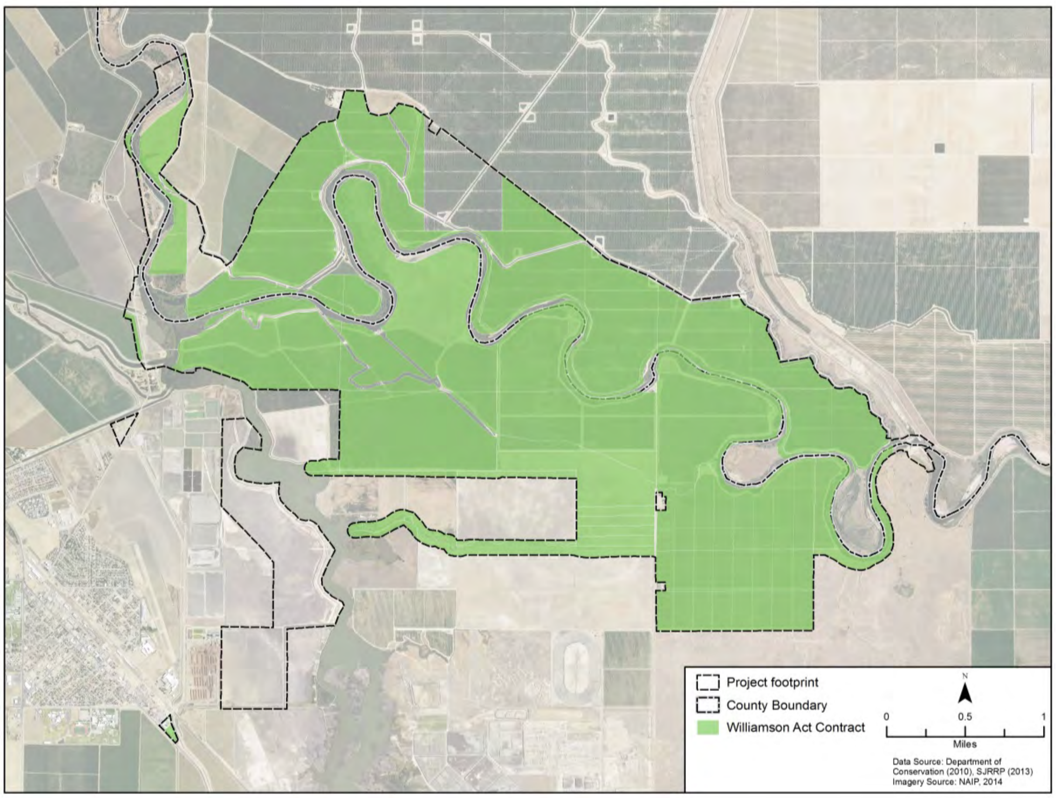

Figure 16-5.
Lands under Williamson Act Contract

Table 16-5.
Lands under Williamson Act Contract

Type	Acres	Percent (%)
Williamson Act Contract	4,508	76.5
Not Under Williamson Act Contract	1,386	23.5
Total	**5,894**	**100.0**

Source: DOC 2010a

16.1.4 Land Use Planning

Land use planning in the Project area is implemented by local governments, namely Fresno and Madera counties. Land use planning is dictated by applicable zoning regulations and general plans. Zoning ordinances govern current land use, including allowable land uses, intensity of use, and property development standards, while general plans provide the framework for future land use with a typical planning horizon of 15 to 25 years. For this analysis, various land use designations, as defined in the Fresno and Madera counties' general plans, were combined into common classifications. These designations reflect each county's vision of ultimate future land uses for the region. As presented in Figure 16-6 and Table 16-6, future land use in the Project area is planned to remain predominantly in agricultural production, with nearly 99 percent of the land area being designated for agricultural use. A relatively small portion of the Project area, approximately 1.3 percent, is designated for urban use by the local planning authorities, which consists of various residential, commercial, and industrial uses.

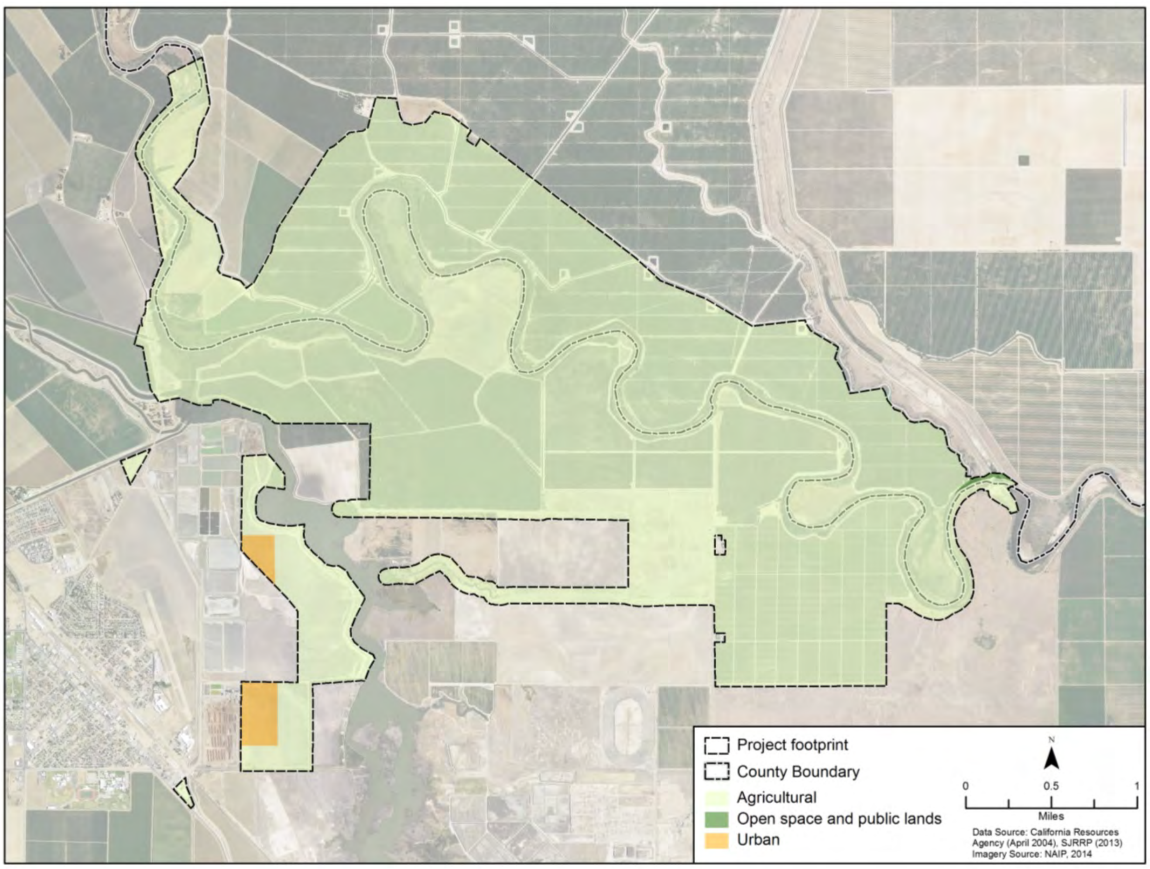

Figure 16-6.
General Plan Land Use Designations

Table 16-6.
General Plan Land Use Designations

Type	Acres	Percent (%)
Agriculture	5,814	98.6
Urban	75	1.3
Open Space / Public lands	5	0.1
Total	**5,894**	**100.0**

Source: California Resources Agency 2004, Fresno County 2013

16.2 Regulatory Setting

The regulatory setting for land use and agricultural resources includes Federal, State, and local/regional regulations. Portions of the information presented below have been excerpted from the San Joaquin River Restoration Program (SJRRP) Program Environmental Impact Statement/Report (PEIS/R).

16.2.1 Federal

Farmland Protection Policy Act of 1981

The Farmland Protection Policy Act is intended to minimize the impact of Federal programs with respect to the conversion of farmland to nonagricultural uses. It ensures that, to the extent possible, Federal programs are administered to be compatible with State, local, and private programs and policies to protect farmland. The National Resources Conservation Service (NRCS) is the agency primarily responsible for implementing the Farmland Protection Policy Act.

The Farmland Protection Policy Act established the Farmland Protection Program and the Land Evaluation and Site Assessment (LESA) system. The NRCS administers the Farmland Protection Program, which is a voluntary program that helps purchase development rights to keep productive farmland in agricultural uses. The program provides matching funds to State, local, and tribal government entities and nongovernmental organizations with existing Farmland Protection Programs to purchase conservation easements. Participating landowners agree not to convert land to nonagricultural uses, and retain all rights to the property for future agriculture. A minimum 30-year term is required for conservation easements, and priority is given to applications with perpetual easements (NRCS 2013a). The LESA system is a tool used to rank lands for suitability and inclusion in the Farmland Protection Program. Land evaluations involve rating soils and placing them into groups ranging from the best to the least suited for a specific agricultural use, such as cropland, forestland, or rangeland. Site assessments involve three major areas: nonsoil factors related to agricultural use of a site, factors related to development pressures, and other public values of a site. Each factor selected is assigned a range of possible values according to local needs and objectives (NRCS 2013b).

16.2.2 State of California

The Public Trust Doctrine

The origins of the Public Trust Doctrine are traceable to Roman law concepts of common property. Under Roman law, the air, the rivers, the sea, and the seashore were incapable of private ownership; they were dedicated to the use of the public (Institutes of Justinian 2.1.1). Under English Common Law, this principle evolved into the Public Trust Doctrine pursuant to which the sovereign held the navigable waterways and submerged lands, not in a proprietary capacity, but as a "trustee of a public trust for the benefit of the people" (*Colberg, Inc. v. State of California ex rel. Dept. Pub. Works*, 67 Cal.2d 408, 416 [1967]).

Upon admission to the Union in 1850, California, as a sovereign state, received fee title to tide and submerged lands, as well as, the lands underlying navigable waterways (collectively referred to as "public trust lands") under the equal-footing doctrine (*Martin v. Waddell*, 41 U.S. 367, 410 [1842]). The Public Trust Doctrine, as a common law doctrine, is not static but is continuously evolving. Pursuant to the Public Trust Doctrine, public trust lands are owned by the State and held in trust for the benefit of the public. Public trust lands are not alienable in that all of the public's interest in them cannot be extinguished (*People v. California Fish Co.*, 166 Cal. 576, 597-99 [1913]; *Illinois Central v. Illinois*, 146 U.S. 387 [1892]; Cal. Const. Article X, Section 4; Pub. Resources Code, § 7991). Public trust lands cannot be bought and sold like other State-owned lands; only in rare cases may the public trust be terminated, and only where consistent with the purposes and needs of the trust (city of Long Beach v. Mansell, 3 Cal. 3d 462 [1970]). These lands are to be used to promote the public's interest in water dependent or water oriented activities including, but not limited to, water-related commerce, navigation, fisheries, environmental preservation and recreation.

The California Legislature, representing the people of California, is the ultimate trustee of California's public trust lands and resources and exercises its authority and responsibility to enact laws to protect and promote prudent use of public trust lands and the living resources therein. *National Audubon Society v. Superior Court*, 33 Cal. 3d 419 (1983) states that the core of the Public Trust Doctrine is the State's authority as sovereign to exercise a continuous supervision and control over the waters of the state to protect ecological and recreational values. The Legislature has delegated to the CSLC exclusive control and jurisdiction over ungranted public trust lands. (Pub. Resources Code, §§ 6216, 6301). The CSLC implements the Public Trust Doctrine through careful consideration of its principles and the exercise of discretion within the specific context and location of proposed uses. In administering its trust responsibilities, the CSLC exercises its discretionary authority in the best interests of the State, accommodating the changing needs of the public while preserving the public's right to use public trust lands for the purposes to which they are uniquely suited.

Use of public trust lands is generally limited to water dependent or related uses, including commerce, fisheries, and navigation, environmental preservation and recreation. Public trust uses include, among others, ports, marinas, docks and wharves, buoys, hunting, commercial and sport fishing, bathing, swimming, and boating. Ancillary or incidental uses – those that directly promote trust use, are directly supportive and necessary for trust use, or that accommodate the public's enjoyment of trust lands – are also permitted. Public trust lands may also be kept in their natural state for habitat, wildlife refuges, scientific study, or use as open space (*Marks v. Whitney*, 6 Cal 3d 251 [1971]). Because public trust lands are held in trust for all citizens of California, they must be used to serve statewide goals, as opposed to purposes that are purely of local benefit (*Mallon v. City of Long Beach*, 44 Cal.2d 199 [1955]; Pub. Resources Code, § 6009). In addition, the living resources (e.g., the fish and aquatic plant and animal life) inhabiting public trust lands and the overlying waters are public trust resources and also subject to the protections of the Public Trust Doctrine.

State Planning and Zoning Laws

California Government Code section 65300 et seq. establishes the obligation of cities and counties to adopt and implement general plans. A general plan is a comprehensive, long-term strategy document that sets forth the expected location and general type of physical development expected in the city or county developing the document. The plan also may consider land outside its boundaries that, in the city's or county's judgment, may affect land use activities within its borders. The general plan addresses a broad range of topics, including, at a minimum, land use, circulation, housing, conservation, open space, noise, and safety. In addressing these topics, the general plan identifies the goals, objectives, policies, principles, standards, and plan proposals that support the city's or county's vision for the area. The general plan is a long-range document that typically addresses development over a 20-year period. Although the general plan serves as a blueprint for future development and identifies the overall vision for the planning area, it remains general enough to allow flexibility in the approach taken to achieve the plan's goals.

The State Zoning Law (Gov. Code, § 65800 et seq.) establishes that zoning ordinances, which are laws that define allowable land uses in a specific district, are required to be consistent with the general plan and any applicable specific plans. When amendments to the general plan are made, corresponding changes in the zoning ordinance may be required within a reasonable time to ensure that the land uses designated in the general plan also would be allowable by the zoning ordinance (Gov. Code, § 65860, subd. (c)).

Williamson Act

The California Land Conservation Act of 1965, commonly known as the Williamson Act, was enacted when population growth and rising property taxes were recognized as a threat to the viability of valuable farmland in California. It enables local governments to enter into contracts with private landowners to promote the continued use of relevant land in agricultural or related open space use. In return, landowners receive property tax assessments that are based on farming and open space uses instead of full market value. Local governments receive an annual subvention (subsidy) of forgone property tax revenues from the State via the Open Space Subvention Act of 1971.

The Williamson Act empowers local governments to establish "agricultural preserves" consisting of lands devoted to agricultural and other compatible uses. After such preserves are established, the locality may offer to owners of included agricultural land the opportunity to enter into annually renewable contracts that restrict the land to agricultural use for at least 10 years (i.e., the contract continues to run for 10 years following the first date on which the contract is not renewed). In return, the landowner is guaranteed a relatively stable tax rate, based on the value of the land for agricultural/open space use only, and is unaffected by its development potential.

Contracts can be terminated only by a cancellation or nonrenewal. Cancellation of a Williamson Act contract involves an extensive review and approval process, in addition to payment of fees of up to 12.5 percent of the property value. The local jurisdiction approving the cancellation must find that the cancellation is consistent with the purpose of the California Land Conservation Act or is in the public interest. Several subfindings must be made to support either finding, as defined in Government Code section 51282. However, the Project may not require any cancellation procedure besides notification, because the land is needed by a public agency for a public use, as described in Government Code section 51291. This issue is described in the Project's *Technical Memorandum on Regulatory Compliance* (SJRRP 2011b) and Chapter 27, "Consultation, Coordination, and Compliance."

Filing for a nonrenewal, which can be done unilaterally by either the property owner or the local government, initiates a gradual increase in the property tax rate over the 10-year renewal period until it reaches the market rate by the end of the term. During the nonrenewal period, the property continues to be limited to uses allowed by the Williamson Act.

Farmland Security Zones

In August 1998, the legislature enhanced the Williamson Act with the Farmland Security Zone provisions. Farmland Security Zones, also known as Super Williamson Act lands, were established by the DOC with the same intent as Williamson Act contracts. The Farmland Security Zone provisions offer landowners greater property tax reductions in return for a minimum rolling contract term of 20 years. A Farmland Security Zone must be located in an Agricultural Preserve (area designated as eligible for a Williamson Act contract) and designated as Prime Farmland, Farmland of Statewide Importance, Unique Farmland, or Farmland of Local Importance. Land protected in a Farmland Security Zone cannot be annexed by a city or county government or school district. Farmland Security Zone contracts constitute nearly 2 percent of statewide Williamson Act enrollment (DOC 2007a).

A Farmland Security Zone can be terminated through a nonrenewal or cancellation. The nonrenewal allows a rollout process to occur over the remainder of the term of the contract, when the tax rates would gradually rise to the full rate by the end of the 20-year term. A cancellation must be applied for and approved by the director of the DOC, and specific criteria must be met. The cancellation must be in the public interest and consistent with Williamson Act criteria. If a cancellation is approved, fees equal to 25 percent of the full market value of the property must be paid (DOC 2007a).

California Important Farmland Inventory System and Farmland Mapping and Monitoring Program

The DOC maintains a statewide inventory of farmlands. These lands are mapped by the Division of Land Resource Protection as part of the FMMP. The FMMP was established by the State in 1982 to continue the Important Farmland mapping efforts begun in 1975 by the U.S. Soil Conservation Service (now called the NRCS). The intent of the NRCS was to produce agricultural resource maps based on soil quality and land use across the nation. The maps are updated every 2 years with the use of aerial photographs, a computer mapping system, public review, and field reconnaissance. As part of the nationwide effort to map agricultural land uses, the NRCS developed a series of definitions known as Land Inventory and Monitoring criteria. The Land Inventory and Monitoring criteria classify land's suitability for agricultural production. Suitability includes both physical and chemical characteristics of soils, as well as the actual land use. Maps of Important Farmland are derived from NRCS soil survey maps using the Land Inventory and Monitoring criteria and are available by county (DOC 2007b).

California Farmland Conservancy Program

The California Farmland Conservancy Program is a statewide grant funding program that supports local efforts to establish agricultural conservation easements and planning projects for the purpose of preserving important agricultural land resources (DOC 2007c). The California Farmland Conservancy Program provides grants to local governments and qualified nonprofit organizations for the following (DOC 2007d):

- Voluntary acquisition of conservation easements on agricultural lands that are under pressure of being converted to nonagricultural uses.
- Temporary purchase of agricultural lands that are under pressure of being converted to nonagricultural uses, as a phase in the process of placing agricultural conservation easements on farmland.
- Agricultural land conservation policy and planning projects.
- Restoration of and improvements to agricultural land already under easement.

Land Evaluation and Site Assessment Model (California)

Based on the Federal LESA system, the California LESA model was developed in 1997 to provide lead agencies with an optional methodology to ensure that potentially significant effects on the environment of agricultural land conversions are quantitatively and consistently considered in the environmental review process, including California Environmental Quality Act (CEQA) reviews. The California Agricultural LESA model evaluates measures of soil resource quality, a given project's size, water resource availability, surrounding agricultural lands, and surrounding protected resource lands. For a given project, the factors are rated, weighted, and combined, resulting in a single numeric score. The project score becomes the basis for determining a project's potential significance (DOC 1997).

16.2.3 Regional and Local

Regional and local regulations pertaining to land use and agricultural resources are based on allowable uses and policies outlined in local zoning and general plans implemented by Fresno and Madera counties.

Zoning

Zoning regulates the location of land uses and the development standards to which new development must be built. The purposes of establishing zoning designations are to ensure that neighboring land uses are compatible with one another and to regulate and protect the uses in which land may be placed. Each zoning designation contains specific regulations controlling the uses of land; density of population/structures; use, location, and dimensions of structures; open space/setback requirements; and access considerations.

Both Fresno and Madera counties implement their own set of zoning regulations. These regulations are applied when land is initially developed or redeveloped through permitting requirements. Based on existing land uses, it is assumed that zoning on most parcels in the Project area is “agricultural” in nature. Generally, agricultural zoning is designed to support and enhance agriculture land use and open spaces. The general descriptions of agricultural zoning designations in the two-county region are summarized below.

Agricultural zoning designations in Fresno County that are likely to be applicable to most land in the Project area include the following (Fresno County 2004):

- The **"AE" District** is intended to be an exclusive district for agriculture and for those uses which are necessary and an integral part of the agricultural operation. This district is intended to protect the general welfare of the agricultural community from encroachments of nonrelated agricultural uses which by their nature would be injurious to the physical and economic well-being of the agricultural district.
- The **"AL" District** is a limited agricultural district. It is intended to protect the general welfare of the agricultural community by limiting intensive uses in agricultural areas where such uses may be incompatible with, or injurious to, other less intensive agricultural operations. The district is also intended to reserve and hold certain lands for future urban use by permitting limited agriculture and by regulating those more intensive agricultural uses which, by their nature, may be injurious to nonagricultural uses in the vicinity or inconsistent with the express purpose of reservation for future urban use.

Agricultural zoning designations in Madera County include the following which focus on lot size (Madera County 2015):

- AR-5 Agricultural, Rural, Five Acre District..
- ARE-20 Agricultural Rural, Exclusive Twenty Acre District.
- AEX-20 Agricultural Exclusive, Twenty Acre District.

- ARE-40 Agricultural Rural, Exclusive Forty Acre District.
- AEX-40 Agricultural, Exclusive Forty Acre District.
- ARE-80, 160, 320, 640 Agricultural, Rural, Exclusive, 80 to 640 Acre District.
- ARV-20 Agricultural, Rural, Valley, Twenty Acre District.
- ARF Agricultural, Rural, Foothills District.

General Plans

As described above, each county and city in the state is required by Government Code section 65300 to have a comprehensive, long-term general plan for the physical development of the county or city. This section summarizes key features related to agriculture and open space in the general plans developed for Fresno and Madera counties. Representative general plan land use designations applicable to the Project area are presented in Section 16.1.4. These land use designations are implemented mainly through the local zoning ordinances referenced above.

Fresno County General Plan

The Fresno County General Plan was adopted in 2000 and is in the process of being updated. The two primary components of the General Plan that are applicable to the Project are the *Agriculture and Land Use Element* and *Open Space and Conservation Element*. Generally, general plan policies applicable within Fresno County are focused on maintaining the long-term viability of agriculture in the region (Fresno County 2000).

Madera County General Plan

The Madera County General Plan Policy Document, adopted in October 1995, is a stand-alone document that is part of the Madera County General Plan. Key general policies related to the protection of agriculture in Madera County are covered under the *Agriculture and Natural Resource* section of the plan (Madera County 1995).

16.3 Environmental Consequences and Mitigation Measures

16.3.1 Impact Assessment Methodology

The focus of this section is on physical changes in existing land use patterns in the Project area including agriculture, and secondarily, the consistency of the Project with local and regional land use plans and programs in Fresno and Madera counties.

To evaluate potential impacts on agricultural resources, the proposed footprint of the Project construction activities and long-term operational scenarios was evaluated in the context of existing agricultural operations to determine the extent (in acres) to which agricultural lands would be permanently removed from production. This evaluation was based on spatial overlays of the Project features (including borrow areas) on existing land use maps developed for the Project using Geographic Information System (GIS) analysis. In addition, the agricultural impact analysis also considered information on cropping patterns and representative crop yields to fully evaluate the magnitude of impacts on agricultural values, which are evaluated in the Chapter 21.0, "Socioeconomics and Economics."

The groundwater resource analysis of potential seepage and high water table impacts was used to determine the extent of agricultural lands not proposed to be removed from production that could be affected in terms of agricultural productivity. This impact is evaluated qualitatively.

The assessment of agricultural resources also considered impacts related to conversion of designated Farmland (under the FMMP) to non-agricultural uses, as well as conflicts with Williamson Act contracts. This analysis evaluates the extent to which designated Farmland and properties under Williamson Act contract would be affected by the Project footprint using GIS analysis.

From a planning perspective, the Project is also evaluated with respect to its consistency with local general plans administered by Fresno and Madera counties. These plans have been reviewed in the context of Project activities to focus only on those sections that are relevant to the Project, including proposed land uses in the Project area, as well as policies related to open space preservation, conservation, and agriculture.

16.3.2 Significance Criteria

The Project was evaluated in accordance with the agricultural resources and land use and planning sections of the Environmental Checklist Form in Appendix G of the State CEQA Guidelines, as amended. Under National Environmental Policy Act (NEPA) Council on Environmental Quality Regulations, effects are evaluated in terms of their context and intensity. These factors have been considered when applying the State CEQA Guidelines. The Project would result in a significant impact on land use and agriculture if it would:

- Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance, as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Natural Resources Agency, to non-agricultural use.
- Conflict with existing zoning for agricultural use or a Williamson Act contract.
- Conflict with existing zoning for, or cause rezoning of, forest land (as defined in Pub. Resources Code, § 12220, subd. (g)), timberland (as defined in Pub. Resources Code, § 4526), or timberland zoned Timberland Production (as defined in Pub. Resources Code, § 51104, subd. (g)).
- Result in the loss of forest land or conversion of forest land to non-forest use.
- Involve other changes in the existing environment that, because of their location or nature, could result in conversion of Important Farmland to nonagricultural use or the substantial diminishment of agricultural land resource quality or importance.
- Physically divide an established community.

- Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the Project (including, but not limited to the general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect.
- Conflict with any applicable habitat conservation plan or natural community conservation plan.

16.3.3 Impacts and Mitigation Measures

This section provides an evaluation of the direct and indirect effects of the Project Alternatives on agricultural and other land uses in the Project area. It includes analyses of potential effects relative to No-Action conditions in accordance with NEPA and potential impacts compared to existing conditions to meet CEQA requirements. The analysis is organized by Project alternative with specific impact topics numbered sequentially under each alternative. With respect to agricultural and land use, the environmental impact topics are:

1. Removal of Land from Agricultural Production.
2. Conversion of Designated Farmland to Non-Agricultural Uses.
3. Conflict with Williamson Act Contracts.
4. Degradation of Agricultural Land Productivity due to Seepage.
5. Conflict with Applicable Land Use Plans Regarding Agricultural Lands.
6. Diminishment of Agricultural Production by Increased Disease.

Other agriculture and land use-related issues covered in the PEIS/R are not covered here because they are programmatic in nature and/or are not relevant to the Project area. These include conversion of riparian forest to non-forest uses; physically divide or disrupt an established community; potential conversion of riparian forest because of altered inundation; and substantial diminishment of agricultural land resource quality and importance because of altered water deliveries. The issue of potential conflicts with habitat conservation plans is addressed in Chapter 7.0, “Biological Resources – Wildlife."

No-Action Alternative

Under the No-Action Alternative, the Project would not be implemented and none of the Project features would be developed in Reach 2B of the San Joaquin River. Existing levee alignments and heights would be maintained and maximum conveyance would be limited to the existing channel capacity. However, other proposed actions under the SJRRP would be implemented, including habitat restoration in other reaches, augmentation of river flows, and reintroduction of salmon. Without the Project in Reach 2B, however, Program-level activities would not achieve the Settlement goals. For the No-Action Alternative, the analysis of effects related to agricultural resources and land use is based on a comparison to existing conditions. No mitigation is required for No-Action.

Impact LU-1 (No-Action Alternative): ***Removal of Land from Agricultural Production***. Under the No-Action Alternative, the Project would not be implemented;

therefore, there would be no direct effects on agricultural production in the Project area associated with habitat restoration activities and/or construction and operation of new facilities. However, program-wide restoration activities would still be implemented, including Restoration Flows in the San Joaquin River. In Reach 2B, Restoration Flows would not exceed channel capacity and flood flows would be contained within the existing river channel or diverted into the Chowchilla Bypass when flood releases approach channel capacity, thereby avoiding direct effects on agricultural production in the Project area. (Indirect effects from seepage are described below under Impact LU-4.) Further, it is unlikely that agricultural land would be developed to accommodate potential population growth based on implementation of program-wide restoration activities in adjacent reaches of the river, which would discourage urban development in the region. Compared to existing conditions, no lands would be removed from production. There would be **no impact** associated with removing land from agricultural production under the No-Action Alternative.

Impact LU-2 (No-Action Alternative): ***Conversion of Designated Farmland to Non-Agricultural Uses***. Under the No-Action Alternative, there would be no direct effects on agricultural production in the Project area; refer to Impact LU-1 (No-Action Alternative) above. Accordingly, farmland designated as Prime Farmland, Unique Farmland, or Farmland of Statewide Importance within the Project area would remain in agricultural production. Compared to existing conditions, there would be **no impact** associated with the conversion of designated Farmland to non-agricultural uses under the No-Action Alternative.

Impact LU-3 (No-Action Alternative): ***Conflict with Williamson Act Contracts***. Under the No-Action Alternative, there would be no direct effects on agricultural production in the Project area; refer to Impact LU-1 (No-Action Alternative) above. Therefore, agricultural lands in the Project area which are under Williamson Act contract would remain in active production and would remain in compliance with all contract provisions related to continued agricultural use. Compared to existing conditions, there would be **no impact** associated with conflicts with Williamson Act contracts under the No-Action Alternative.

Impact LU-4 (No-Action Alternative): ***Degradation of Agricultural Land Productivity due to Seepage***. Prior to the start of Interim Flows in October 2009, portions of the Project area historically experienced groundwater seepage to adjacent lands during elevated flood flows. Under the No-Action Alternative, Restoration Flows could affect agricultural lands in Reach 2B that have historically experienced groundwater seepage. Restoration flows could saturate areas for longer and more frequent periods, than flood flows under prior conditions. Restoration flows also could inundate areas during seasons when flood flows do not typically occur (i.e., summer and fall). These changes in duration, frequency, and seasonality could affect agricultural productivity by saturating soil in the rooting zone, impairing plant growth and survival, temporarily reducing grazing suitability, or interfering with the ability to use machinery to work soil. Most of these effects would be adverse and may necessitate changes in cropping patterns or grazing practices. At some sites, these adverse changes could cause agricultural land to be idled or otherwise reduce the land's quality and importance for agriculture. However, Program-level seepage management measures would be implemented in the Project area that would minimize impacts to agricultural resources under the No-Action Alternative. Specifically, Restoration Flows would be managed such that the capacity of Reach 2B would not be exceeded. Consequently, adverse effects to agricultural productivity from Restoration Flows in Reach 2B would be minimized under the No-Action Alternative. Compared to existing conditions, there would be a **less-than-significant** impact related to the degradation of agricultural land productivity due to seepage of Restoration Flows under the No-Action Alternative.

Impact LU-5 (No-Action Alternative): ***Conflict with Applicable Land Use Plans Regarding Agricultural Lands***. Under the No-Action Alternative, there would be no direct change in existing agricultural or other land uses in the Project area. Although agricultural productivity may be affected due to seepage, the area would not be developed and would retain its agricultural character. As such, the No-Action Alternative would not conflict with applicable zoning regulations or general plan land use designations implemented by Fresno and Madera counties. Compared to existing conditions, there would be **no impact** related to conflicts with applicable land use plans in the Project area.

Impact LU-6 (No-Action Alternative): ***Diminishment of Agricultural Production by Increased Disease***. Under the No-Action Alternative, additional riparian vegetation upstream of the San Mateo Avenue crossing could affect the incidence of some orchard and vineyard diseases on adjacent land by serving as a source of causal organisms. However, the additional sources of causal organisms would not substantially reduce agricultural activity for several reasons: disease-causing organisms could already occur on a variety of widely planted fruit and nut crops present in the Project area, the incidence of disease is not solely or even primarily determined by the presence of causal organisms in the vicinity of an orchard or vineyard, and incidence of disease is only one of many factors affecting agricultural productivity. This impact would be **less than significant**.

Alternative A (Compact Bypass with Narrow Floodplain and South Canal)

All of the Project alternatives, including Alternative A, propose habitat restoration activities in conjunction with an expanded floodplain and widened levee alignments, as well as new Project facilities that promote fish passage through Reach 2B. This alternative includes passive riparian habitat restoration and farming in the floodplain. Under Alternative A, agricultural uses that are suitable within the proposed floodplain would be allowed. Construction activity is expected to occur intermittently over an approximate 132-month timeframe.

Impact LU-1 (Alternative A): ***Removal of Land from Agricultural Production***. Compared to No-Action, Alternative A would result in the removal of land from agricultural production in the Project area. As shown in Table 16-7, there are approximately 4,166 acres of land in agricultural production in the footprint of Alternative A. Of this total, about 1,232 acres would be subject to permanent loss of agricultural production, which includes the area underlying the proposed levee alignments and structures, borrow areas, and passive riparian habitat restoration areas within the floodplain. In addition, another 56 acres of farmland would be temporarily disturbed during the 11-year construction period to accommodate features such as staging areas and access roads. Agricultural activity would be allowed on the floodplain within the proposed levee alignment (outside riparian habitat restoration areas) under Alternative A, up to 579 acres,[3] however, because this area would be subject to frequent inundation, it is likely that agricultural activity would primarily be livestock grazing, a relatively low-value type of agriculture use compared to permanent and annual crop production that generate higher economic returns. Agricultural production on the remaining farmland within Alternative A, roughly 2,299 acres, would not be affected.

Table 16-7.
Effects on Agricultural Land Uses

Type of Agricultural Effect	Alt. A (acres)	Alt. B (acres)	Alt. C (acres)	Alt. D (acres)
Permanent Agricultural Loss [a]	1,232	1,032	1,567	1,347
Temporary Agricultural Loss	56	42	73	69
Shift in Agricultural Land Use	579	886	0	956
No Agricultural Effect [b]	2,299	2,252	2,450	1,835
Total	***4,166***	***4,212***	***4,090***	***4,208***

Notes:
[a] Includes 350 acres of borrow area that are assumed to permanently removed from production.
[b] Includes land within potential borrow areas that are outside the required 350 acres of borrow pits.

Table 16-8 shows agricultural impacts by crop type. The Project would affect both permanent and annual crops, with the greatest impacts expected on almonds, which account for about 31 percent of the agricultural land that would be taken out of production permanently.[4] Other crops that would be taken out of production on a long-term basis include, but are not limited to, pistachios (15 percent), grapes (13 percent), row crops (13 percent), and vacant agricultural land (23 percent).

When comparing Alternative A to existing conditions, impacts to agricultural land uses would be similar to those described in the preceding paragraphs (i.e., the comparison of Alternative A to No-Action). In summary, the Project would remove agricultural land from production over both the short term (i.e., during construction) and long term (i.e., into perpetuity) as lands are managed to meet the objectives and goals of the Settlement Agreement; this impact is considered **significant**.

[3] This is an assumed value that provides a maximum amount of agricultural activity on the floodplain while still allowing for riparian habitat restoration in the Project area.
[4] These values account for both the permanent loss and the shift in agricultural activity for each type of crop.

Table 16-8.
Agricultural Effects by Crop Type, Alternative A

Crop Type	Type of Effect			
	Permanent Loss (acres)	Temporary Loss (acres)	Shift in Agricultural Activity (acres)	No Effect (acres)
Alfalfa	36	3	12	29
Almonds	399	3	163	1,321
Cotton	2	0	0	5
Grapes	224	20	11	368
Grazing	41	0	0	1
Other Row Crop	200	8	35	332
Palm	8	0	2	0
Pistachio	124	20	145	230
Agriculture-Vacant	200	1	212	13
Total	**1,232**	**56**	**579**	**2,299**

Mitigation Measure LU-1 (Alternative A): ***Preserve Agricultural Productivity of Designated Farmland to the Extent Possible.*** Project proponents will recognize and minimize adverse effects on agricultural lands to the extent practicable, including modification of construction practices. The following activities would minimize adverse effects on existing agricultural land in production and limit the extent of farmland that would be converted to non-agricultural uses. However, this mitigation measure will not fully avoid the conversion of substantial amount of agricultural land to non-agricultural uses, and there are no additional measures to fully mitigate the loss of farmland; therefore, this impact would be **significant and unavoidable**.

Implementation Action: The following actions will be implemented opportunistically, where feasible, appropriate, and consistent with the purpose, need, and objectives of the Project. These following measures are summarized, in part, from the Record of Decision (ROD) for the San Joaquin Restoration Program (SJRRP 2012b):

- When selecting sites for borrow excavation, minimize the fragmentation of lands that are to remain in agricultural use and retain contiguous parcels of agricultural land of sufficient size to support their efficient use for continued agricultural production.
- Where the levee system would transect agricultural properties, and the landowners desire to continue agricultural use on the portions located within the levee system, provide a means of convenient access to these properties.

- The Project proponent will either (1) acquire agricultural conservation easements for designated Farmland/Important Farmland[5] at a 1:1 ratio to be held by land trusts or public agencies who will be responsible for enforcement of the deed restrictions maintaining these lands in agricultural use, or (2) provide funds to a land trust or government program that conserves agricultural land sufficient to obtain easements on comparable land at a 1:1 ratio.
- Stockpile the upper 2 feet of soil from Project structural feature footprints that are designated Farmland. Stockpiled soil would be used in subsequent restoration of agricultural uses or redistributed for agricultural purposes.
- Restore for agricultural uses in those portions of borrow sites and of levee, bypass, and other Project feature footprints that are designated Farmland and are not converted to Project features, managed habitat, or Project mitigation for nonagricultural impacts. Restoration for agricultural use would include redistribution of salvaged topsoil and earthwork for necessary irrigation and drainage.
- Redistribute the most productive salvaged topsoil from structural feature footprints that is not used in restoring agricultural uses to affected designated Farmland. Redistribution will be to less productive agricultural lands near but outside the levee setback and Mendota Pool. Bypass areas that could benefit from the introduction of good-quality soil. By agreement between U.S. Department of the Interior, Bureau of Reclamation (Reclamation) or landowners of affected properties and the recipient(s) of the topsoil, the recipient(s) must use the topsoil for agricultural purposes.
- Minimize disturbance of designated Farmland and continuing agricultural operations during construction by implementing the following measures: (1) locate construction laydown and staging areas on sites that are fallow, disturbed, or to be discontinued for use as agricultural land to the extent possible, and (2) use existing roads to access construction areas to the extent possible.
- Coordinate with growers to develop appropriate construction practices to minimize construction-related impairment of agricultural productivity. Practices may include coordinating the movement of heavy equipment within the levee setback and Mendota Pool Bypass areas and implementing traffic control measures outside these areas.
- Comply with California Government Code sections 51290–51295 with regard to acquiring lands under Williamson Act contract. Specifically, whenever it appears that land within a preserve or under contract may be required for a public improvement, the DOC and the city or county responsible for administering the preserve must be notified (§ 51291, subd. (b)). Within 30 days of being notified, the DOC and the city or county would forward

[5] The term “designated Farmland” used in this section is synonymous with “Important Farmland” as referenced in the ROD (DOC classifications: Prime Farmland, Unique Farmland, and Farmland of Statewide Importance).

comments, which would be considered by the Project proponents (§ 51291, subd. (b)). The Williamson Act contract would be terminated when the land is acquired (§ 51295). The DOC would be notified within 10 working days upon completion of the land acquisition (§ 51291, subd. (c)). If, after acquisition, the Project proponents determine that the property would not be used for the proposed public improvement, the DOC and the city or county administering the involved preserve will be notified before the land is returned to private ownership. The land would be reenrolled in a new contract or encumbered by an enforceable restriction at least as restrictive as that provided by the Williamson Act (§ 51295).

- The Project proponent will coordinate with landowners and agricultural operators to sustain existing agricultural operations, at the landowners' discretion, within the Project area until the individual agricultural parcels are needed for Project construction.

Location: Agricultural lands within the Project area.

Effectiveness Criteria: Effectiveness will be based on annual reporting of the number of acres removed from agricultural production during implementation.

Responsible Agency: Reclamation and CSLC.

Monitoring/Reporting Action: Adequacy of the proposed activities will be confirmed with Reclamation project managers and CSLC monitors.

Timing: Mitigation will be ongoing over the construction timeframe.

Impact LU-2 (Alternative A): ***Conversion of Designated Farmland to Non-Agricultural Uses***. Compared to No-Action, Alternative A would result in the conversion of designated Farmland in the Project area to non-agricultural uses (Table 16-9). For this analysis, Farmland under the FMMP covers land designated as Prime Farmland, Farmland of Statewide Importance, and Unique Farmland. Specifically, Alternative A would permanently remove 786 acres of Prime Farmland, 94 acres of Farmland of Statewide Importance, and 120 acres Unique Farmland from agricultural production to accommodate the proposed levees, floodplain restoration, and Project structures.[6] An additional 350 acres of land would be required for borrow material to support construction activities; the exact location of the borrow areas is not known, although they are likely to occur on designated Farmland, which comprises about 88 percent of potential borrow areas under Alternative A. During construction, another 65 acres of designated Farmland would be temporarily taken out of production, but could return to active agriculture once the Project is complete. Lastly, approximately 480 acres of designated Farmland is located within the proposed floodplain, which would be available for agricultural activity (likely livestock grazing).

[6] These assumed values provide a maximum amount of agricultural activity on the floodplain while still allowing for riparian habitat restoration in the Project area.

Table 16-9.
Conversion of Designated Farmland

Farmland	Alt. A (acres)	Alt. B (acres)	Alt. C (acres)	Alt. D (acres)
Permanent Loss of Designated Farmland [a]				
Prime Farmland	786	585	939	917
Farmland of Statewide Importance	94	86	163	112
Unique Farmland	120	114	116	113
Additional Farmland within the Floodplain [b]	≤480	≤786	--	≤862
Borrow Areas	≤350	≤350	≤350	≤350
Temporary Loss of Designated Farmland [a]				
Staging Areas	65	50	81	77

Note:
[a] Designated Farmland includes Prime Farmland, Farmland of Statewide Importance, and Unique Farmland
[b] Primarily converted to open space or grazing land.

With some of the Project features, particularly where farmland remains undeveloped, the land would retain some of its agricultural value and long-term agricultural viability; however, because the proposed Reach 2B component of the Restoration Program is a long-term effort, these lands would not likely return to active crop production and are considered to be converted to non-agricultural uses.

When comparing Alternative A to existing conditions, impacts to designated Farmland under the FMMP would be similar to those described in the preceding paragraph (i.e., the comparison of Alternative A to No-Action). In summary, the Project would remove Prime Farmland, Farmland of Statewide Importance, and Unique Farmland from production over both the short and long term; this impact is considered **significant**.

Mitigation Measure LU-2 (Alternative A): ***Preserve Agricultural Productivity of Designated Farmland to the Extent Possible.*** Refer to Mitigation Measure LU-1 (Alternative A). The same mitigation measure would apply to this impact. Project proponents will recognize and minimize adverse effects on agricultural lands to the extent practicable, including modification of construction practices. However, this mitigation measure would not fully avoid the conversion of agricultural land to non-agricultural uses, and there are no additional measures to fully mitigate the loss of farmland; therefore, this impact would be **significant and unavoidable**.

Impact LU-3 (Alternative A): ***Conflict with Williamson Act Contracts***. Compared to No-Action, implementation of Alternative A would result in potential conflicts with Williamson Act contracts in effect on agricultural properties in the Project area. In total, approximately 433 acres under Williamson Act contract are located in areas underlying the proposed levee system and other Project facilities, 81 acres in areas subject to temporary disturbance during construction, and 1,211 acres in areas within the proposed floodplain. In addition, about 350 acres of land would serve as borrow areas that are likely to be under a Williamson Act contract.

Generally, land uses and improvements on lands enrolled in Williamson Act contracts are limited to commercial agriculture or uses determined to be compatible or incidental to commercial agriculture. Project infrastructure (e.g., the proposed levee system and other facilities) and habitat restoration areas are not considered compatible or incidental to agriculture. However, under Alternative A, agricultural activity (likely livestock grazing) would be allowed on lands within the proposed floodplain outside passive riparian and floodplain habitat restoration areas; livestock grazing would likely be consistent with Williamson Act contracts in effect on these lands.

Although conflicts with the Williamson Act contracts are relative to existing contract provisions and portions of the Project area may be considered a "compatible use" under the Williamson Act, for the purpose of this analysis it is assumed that Williamson Act contracts would be canceled during land acquisition. Further, there would be no effect on existing agricultural landowners with respect to additional tax burdens as they would no longer own the land.

When comparing Alternative A to existing conditions, impacts to Williamson Act contracts would be similar to those described in the preceding paragraph (i.e., the comparison of Alternative A to No-Action). In summary, long-term restoration activities that are not consistent with or incidental to commercial agriculture would likely conflict with provisions in existing Williamson Act contracts in place in the Project area; this impact is considered **significant**.

Mitigation Measure LU-3 (Alternative A): ***Preserve Agricultural Productivity of Designated Farmland to the Extent Possible.*** Refer to Mitigation Measure LU-1 (Alternative A). The same mitigation measure would apply to this impact. Project proponents will recognize and minimize adverse effects on agricultural lands to the extent practicable, including modification of construction practices. However, this mitigation measure would not fully avoid the conversion of agricultural land to non-agricultural uses, and there are no additional measures to fully mitigate the loss of farmland; therefore, this impact would be **significant and unavoidable**.

Impact LU-4 (Alternative A): ***Degradation of Agricultural Land Productivity due to Seepage***. Under Alternative A, groundwater modeling indicates that approximately 380 acres of land outside the levee alignments could be subject to groundwater levels less than 7 feet below ground surface and a 320-acre subset of that area would be subject to groundwater levels less than 5 feet below ground surface; refer to Impact GRW-2 (Alternative A) in Section 13.3.3. To the extent that these seepage-affected areas are in agricultural production, there would be potential effects on the agricultural productivity of the land due to waterlogging of crops. However, a range of seepage control measures are incorporated into the Project that would avoid or minimize seepage outside the levee alignments. Seepage control measures implemented in the Project area could include slurry walls, interceptor drains, seepage wells, seepage berms, land acquisition (fee title or seepage easements) and other measures (see Section 2.2.4). Accordingly, potential effects on agricultural production would be avoided or minimized.

Compared to the No-Action Alternative, where adverse effects to agricultural production in the Project area would be minimized by the Program's activities to control flow through the reach, Alternative A would have similar effects to agricultural productivity on lands potentially affected by seepage in the Project area because seepage effects would be minimized by seepage control measures included as Project actions.

Compared to existing conditions, where seepage effects occurred only during flood flow years in Reach 2B (instead of the potential for more frequent seepage issues with Restoration Flows), Alternative A could potentially have an adverse effect on agricultural productivity in the Project area due to the additional capacity for Restoration Flows which would occur every year. However, with the seepage-related measures integrated into the Project (see Section 2.2.4), this impact would be **less than significant**.

Impact LU-5 (Alternative A): ***Conflict with Applicable Land Use Plans Regarding Agricultural Lands***. Current and future land use in the Project area is guided by the zoning ordinances and general plans maintained by Fresno and Madera counties. As shown in Table 16-6 above, nearly all of the land in the Project area is zoned and designated for agricultural use. In addition, corresponding land use policies are generally intended to protect and promote agriculture in the region. Compared to No-Action, Alternative A would result in the long-term conversion of agricultural land to non-agricultural uses, namely open space and conservation uses. As a result, Alternative A would conflict with existing agricultural zoning, general plan designations, and associated agricultural land use policies of Fresno and Madera counties. Because the Project alternatives would not convert land to urban uses, future agricultural production in the Project area would not be precluded, but would be unlikely once project facilities are in place. Properties that are transferred into public ownership and used for Project purposes could be re-classified under applicable zoning ordinances and general plans to reflect land uses proposed under the Project. This change in use would require general plan amendments in both Fresno and Madera counties, and the re-zoning process would be subsequent to these amendments.

Compared to existing conditions, Alternative A would conflict with applicable land use plans maintained by Fresno and Madera counties based on the conversion of agricultural land to other land uses; this impact is considered **potentially significant**.

Mitigation Measure LU-5 (Alternative A): ***Notify County Planning Agencies of General Plan and Zoning Ordinance Inconsistencies.*** Project proponents will recognize and minimize adverse effects on agricultural land use and zoning by notifying Fresno and Madera County planning agencies of any inconsistencies in designations and applicable polices for affected areas. By notifying affected planning agencies of conflicts with current land use plans, the significant impact can be reduced to **less than significant**.

> **Implementation Action:** Fresno and Madera County planning agencies will be notified of any inconsistencies in designations and applicable polices for affected areas.

> **Location:** Agricultural lands within the Project area.

Effectiveness Criteria: Effectiveness will be based on whether updates can be made by county planning agencies.

Responsible Agency: Reclamation and CSLC.

Monitoring/Reporting Action: Notifications of zoning and land use plan inconsistencies will be confirmed with Reclamation project managers and CSLC monitors.

Timing: Formal notification of any zoning and/or land use plan inconsistencies would occur after project approval.

Impact LU-6 (Alternative A): *Diminishment of Agricultural Production by Increased Disease*. Compared to No-Action, additional riparian vegetation and floodplain area along the river could affect the incidence of some orchard and vineyard diseases on adjacent land by serving as a source of causal organisms. Some riparian plants are alternative hosts for the causal organisms of some diseases of fruit and nut crops; for example, *Botryosphaeria dothedia* has been isolated from riparian plants. This bacterium can cause a shoot blight on pistachio and a canker on almonds, and it occurs on a number of crop, ornamental, and wild plants, causing diseases in some of them (Ma et al. 2001). Also, English walnut (*Juglans regia*) and stone fruits (*Prunus* species, including cherries and plums) can invade and persist in riparian vegetation and host disease organisms that also could affect the same species in orchards.

However, for several reasons, riparian vegetation would not substantially reduce agricultural productivity by increasing the incidence of disease. First, disease-causing organisms occur on a variety of fruit and nut crops, and these crops occupy much larger acreages in the Project area than the additional acreage of riparian host plants that would result from Alternative A. Therefore, riparian vegetation would likely be a less important source of disease-causing organisms than orchard and vineyard vegetation. Second, the incidence of disease is not solely or even primarily determined by the presence of causal organisms in the vicinity of an orchard or vineyard. Physical conditions (including weather), irrigation and other management practices, and susceptibility of crop cultivars and their rootstocks, are also important factors in the incidence of disease. Third, incidence of disease is only one of many factors affecting agricultural productivity. For these reasons, implementing Alternative A would not substantially reduce agricultural productivity by increasing disease.

When comparing Alternative A to existing conditions, impacts would be similar to those discussed in the preceding paragraphs (i.e., the comparison of Alternative A to No-Action). For the reasons described above, this impact would be **less than significant**.

Alternative B (Compact Bypass with Consensus-Based Floodplain and Bifurcation Structure), the Preferred Alternative

Similar to all of the Project alternatives, Alternative B proposes habitat restoration activities in conjunction with an expanded floodplain and widened levee alignments, as well as new Project facilities that promote fish passage through Reach 2B. Alternative B has a relatively wider floodplain configuration that is located across agricultural land. Similar to Alternatives A and D, agricultural uses would be allowed within the proposed floodplain under Alternative B. Alternative B also includes a mixture of active and passive riparian and floodplain habitat restoration. Construction activity is expected to occur intermittently over an approximate 157-month timeframe.

Impact LU-1 (Alternative B): ***Removal of Land from Agricultural Production***. Compared to No-Action, Alternative B would result in the removal of land from agricultural production in the Project area. As shown in Table 16-7 above, there are approximately 4,212 acres of land in agricultural production in the footprint of Alternative B. Of this total, about 1,032 acres would be subject to permanent loss of agricultural production, which includes the area underlying the proposed levee alignments and structures, the expanded floodplain, and borrow areas. In addition, another 42 acres of farmland would be temporarily disturbed during the 13-year construction period to accommodate features such as staging areas and access roads. Agricultural activity would be allowed on the floodplain within the proposed levee alignment (outside riparian habitat restoration areas) under Alternative B, up to 886 acres, however, because this area would be subject to frequent inundation, it is likely that agricultural activity would primarily be livestock grazing, a relatively low-value type of agriculture use compared to permanent and annual crop production that generate higher economic returns. Agricultural production on the remaining farmland within Alternative B, roughly 2,252 acres, would not be affected.

Table 16-10 shows agricultural impacts by crop type. The Project would affect both permanent and annual crops, with the greatest impacts expected on almonds, which account for nearly 35 percent of the agricultural land that would be taken out of production permanently. Other crops that would be taken out of production on a long-term basis include pistachios (15 percent of permanent agricultural losses), grapes (15 percent), row crops (10 percent), and vacant agricultural land (22 percent).

When comparing Alternative B to existing conditions (where there is no active habitat restoration in the Project area), impacts to agricultural land uses would be similar to those described in the preceding paragraphs (i.e., the comparison of Alternative B to No-Action). In summary, the Project would remove agricultural land from production over both the short term (i.e., during construction) and long term (i.e., into perpetuity) as lands are managed to meet the objectives and goals of the Settlement Agreement; this impact is considered **significant**.

Table 16-10.
Agricultural Effects by Crop Type, Alternative B

Crop Type	Type of Effect			
	Permanent Loss (acres)	Temporary Loss (acres)	Shift in Agricultural Activity (acres)	No Effect (acres)
Alfalfa	26	0	14	30
Almonds	402	1	259	1,302
Cotton	2	0	0	5
Grapes	107	20	186	310
Grazing	34	0	1	1
Other Row Crop	142	0	43	383
Palm	8	0	2	0
Pistachio	122	20	158	218
Agriculture-Vacant	190	0	224	3
Total	**1,032**	**42**	**886**	**2,252**

Mitigation Measure LU-1 (Alternative B): ***Preserve Agricultural Productivity of Designated Farmland to the Extent Possible.*** Refer to Mitigation Measure LU-1 (Alternative A). The same mitigation measure would apply to this impact. Project proponents will recognize and minimize adverse effects on agricultural lands to the extent practicable, including modification of construction practices. However, this mitigation measure would not fully avoid the conversion of agricultural land to non-agricultural uses, and there are no additional measures to fully mitigate the loss of farmland; therefore, this impact would be **significant and unavoidable**.

Impact LU-2 (Alternative B): *Conversion of Designated Farmland to Non-Agricultural Uses*. Compared to No-Action, Alternative B would result in the conversion of designated Farmland in the Project area to non-agricultural uses (see Table 16-9), namely the permanent removal of 585 acres of Prime Farmland, 86 acres of Farmland of Statewide Importance, and 114 acres Unique Farmland from agricultural production to accommodate the proposed levees, floodplain restoration, and Project structures. Similar to all Project alternatives, an additional 350 acres of land would be required for borrow material to support construction activities; however, the exact location of the borrow areas is not known, although it is likely to occur on designated Farmland, which comprises about 88 percent of potential borrow areas under Alternative B. During construction, an additional 50 acres of designated Farmland would be temporarily taken out of production, but could return to active agriculture once the Project is complete. Lastly, approximately 786 acres of designated Farmland is located within the proposed floodplain, which would be available for agricultural activity (likely livestock grazing).

In cases where farmland remains undeveloped, the land would retain some of its agricultural value and long-term agricultural viability; however, because the proposed Reach 2B component of the Restoration Program is a long-term effort, these lands would not likely return to active crop production and are considered to be converted to non-agricultural uses.

When comparing Alternative B to existing conditions, impacts to designated Farmland under the FMMP would be similar to those described in the preceding paragraph (i.e., the comparison of Alternative B to No-Action). In summary, the Project would remove Prime Farmland, Farmland of Statewide Importance, and Unique Farmland from production over both the short- and long-term; this impact is considered **significant**.

Mitigation Measure LU-2 (Alternative B): ***Preserve Agricultural Productivity of Designated Farmland to the Extent Possible.*** Refer to Mitigation Measure LU-1 (Alternative A). The same mitigation measure would apply to this impact. Project proponents will recognize and minimize adverse effects on agricultural lands to the extent practicable, including modification of construction practices. However, this mitigation measure would not fully avoid the conversion of agricultural land to non-agricultural uses, and there are no additional measures to fully mitigate the loss of farmland; therefore, this impact would be **significant and unavoidable**.

Impact LU-3 (Alternative B): ***Conflict with Williamson Act Contracts***. Compared to No-Action, Alternative B would result in potential conflicts with Williamson Act contracts in effect on agricultural properties in the Project area. In total, approximately 172 acres under Williamson Act contract are located in areas underlying the proposed levee system and other Project facilities, 56 acres in areas subject to temporary disturbance during construction, and 1,543 acres in areas within the proposed floodplain. In addition, about 350 acres of land would serve as borrow areas that are likely to be under a Williamson Act contract.

Generally, land uses and improvements on lands enrolled in Williamson Act contracts are limited to commercial agriculture or uses determined to be compatible or incidental to commercial agriculture. Alternative B infrastructure and habitat restoration areas are not considered compatible or incidental to agriculture. However, under Alternative B, agricultural activity (likely livestock grazing) would be allowed on lands within the proposed floodplain outside riparian and floodplain habitat restoration areas; livestock grazing would likely be consistent with Williamson Act contracts in effect on these lands.

Although conflicts with Williamson Act contracts are relative to existing contract provisions and portions of the Project area may be considered a “compatible use” under the Williamson Act, for the purpose of this analysis it is assumed that Williamson Act contracts would be canceled during land acquisition. Further, there would be no effect on existing agricultural landowners with respect to additional tax burdens as they would no longer own the land.

When comparing Alternative B to existing conditions, impacts to Williamson Act contracts would be similar to those described in the preceding paragraph (i.e., the comparison of Alternative B to No-Action). In summary, long-term restoration activities that are not consistent or incidental to commercial agriculture would likely conflict with

Williamson Act contracts in place in the Project area; this impact is considered **significant**.

Mitigation Measure LU-3 (Alternative B): ***Preserve Agricultural Productivity of Designated Farmland to the Extent Possible.*** Refer to Mitigation Measure LU-1 (Alternative A). The same mitigation measure would apply to this impact. Project proponents will recognize and minimize adverse effects on agricultural lands to the extent practicable, including modification of construction practices. However, this mitigation measure would not fully avoid the conversion of agricultural land to non-agricultural uses, and there are no additional measures to fully mitigate the loss of farmland; therefore, this impact would be **significant and unavoidable**.

Impact LU-4 (Alternative B): ***Degradation of Agricultural Land Productivity due to Seepage***. Under Alternative B, groundwater modeling indicates that outside the levee alignments, approximately 440 acres could be subject to groundwater levels less than 7 feet below ground surface and a 360-acre subset of that area would be subject to groundwater levels less than 5 feet below ground surface; refer to Impact GRW-2 (Alternative B) in Section 13.3.3. To the extent that the areas subject to seepage effects are in agricultural production, there would be potential effects on the agricultural productivity of the land due to waterlogging of crops. However, a range of seepage control measures incorporated into the Project would avoid or minimize seepage outside the levee alignments. Seepage control measures implemented in the Project area could include slurry walls, interceptor drains, seepage wells, seepage berms, land acquisition (fee title or seepage easements) and other measures (see Section 2.2.4). Accordingly, potential effects on agricultural production would be avoided or minimized.

Under No-Action conditions adverse effects to agricultural production in the Project area would be would be minimized by the Program's seepage control measures, such as activities to control flow through the reach. Compared to the No-Action Alternative, Alternative B would result in similar effects to agricultural productivity on lands potentially affected by seepage in the Project area because seepage effects would be minimized by seepage control measures included as Project actions.

Compared to existing conditions, where seepage effects occurred only during flood flow years in Reach 2B (instead of the potential for more frequent seepage issues with Restoration Flows), Alternative B could potentially have an adverse effect on agricultural productivity in the Project area due to the additional capacity for Restoration Flows which would occur every year. However, with the seepage-related measures integrated into the Project (see Section 2.2.4), this impact would be **less than significant**.

Impact LU-5 (Alternative B): ***Conflict with Applicable Land Use Plans Regarding Agricultural Lands***. Under Alternative B, potential conflicts with applicable land use plans would generally be the same as those described for Alternative A; refer to Impact LU-5 (Alternative A) for details. Compared to existing conditions, Alternative B would conflict with applicable land use plans, including the Fresno and Madera County zoning ordinances and general plans based on the conversion of agricultural land to other land uses; this impact is considered **potentially significant**.

Mitigation Measure LU-5 (Alternative B): ***Notify County Planning Agencies of General Plan and Zoning Ordinance Inconsistencies.*** Refer to Mitigation Measure LU-5 (Alternative A). The same mitigation measure would apply to this impact. Project proponents will recognize and minimize adverse effects on agricultural land use and zoning by notifying Fresno and Madera County planning agencies of any inconsistencies in designations and applicable polices for affected areas. By notifying affected planning agencies of conflicts with current land use plans, the significant impact can be reduced to **less than significant**.

Impact LU-6 (Alternative B): ***Diminishment of Agricultural Production by Increased Disease***. Compared to No-Action, additional riparian vegetation and floodplain area along the river could affect the incidence of some orchard and vineyard diseases on adjacent land by serving as a source of causal organisms. However, the additional sources of causal organisms that could result from implementing Alternative B would not substantially reduce agricultural activity for several reasons: disease-causing organisms could already occur on a variety of widely planted fruit and nut crops in the Project area, the incidence of disease is not solely or even primarily determined by the presence of causal organisms in the vicinity of an orchard or vineyard, and incidence of disease is only one of many factors affecting agricultural productivity.

When comparing Alternative B to existing conditions, impacts would be similar to those discussed in the preceding paragraph (i.e., the comparison of Alternative B to No-Action). This impact would be **less than significant**.

Alternative C (Fresno Slough Dam with Narrow Floodplain and Short Canal)

Similar to all of the Project alternatives, Alternative C proposes habitat restoration activities in conjunction with an expanded floodplain and widened levee alignments, as well as new Project facilities that promote fish passage through Reach 2B. Alternative C has a relatively narrow floodplain configuration. Unlike Alternatives A and D, agricultural uses would not be allowed within the proposed floodplain under Alternative C. Alternative C includes active riparian and floodplain habitat restoration. Construction activity is expected to occur intermittently over an approximate 133-month timeframe.

Impact LU-1 (Alternative C): ***Removal of Land from Agricultural Production***. Compared to No-Action, Alternative C would result in the removal of land from agricultural production in the Project area. As shown in Table 16-7 above, there are approximately 4,090 acres of land in agricultural production in the footprint of Alternative C. Of this total, about 1,567 acres would be subject to permanent loss of agricultural production, which includes the area underlying the proposed levee alignments and structures, the expanded floodplain, and borrow areas. In addition, another 73 acres of farmland would be temporarily disturbed during the 11-year construction period to accommodate features such as staging areas and access roads. Agricultural production on the remaining farmland within Alternative C, roughly 2,450 acres, would not be affected.

Table 16-11 shows agricultural effects by crop type. The Project would affect both permanent and annual crops, with the greatest impacts expected on almonds, which account for nearly 35 percent of the agricultural land that would be taken out of production permanently. Other crops that would be taken out of production on a long-term basis include vacant agricultural land (27 percent of permanent agricultural losses), and pistachios (17 percent).

Table 16-11.
Agricultural Effects by Crop Type, Alternative C

Crop Type	Type of Effect			
	Permanent Loss (acres)	Temporary Loss (acres)	Shift in Agricultural Activity (acres)	No Effect (acres)
Alfalfa	28	3	0	37
Almonds	551	1	0	1,334
Cotton	2	7	0	5
Grapes	138	20	0	461
Grazing	38	0	0	1
Other Row Crop	129	20	0	367
Palm	10	0	0	0
Pistachio	266	20	0	232
Agriculture-Vacant	403	1	0	13
Total	**1,567**	**73**	**0**	**2,450**

When comparing Alternative C to existing conditions (where there is no active habitat restoration in the Project area), impacts to agricultural land uses would be similar to those described in the preceding paragraphs (i.e., the comparison of Alternative C to No-Action). In summary, the Project would remove agricultural land from production over both the short term (i.e., during construction) and long term (i.e., into perpetuity) as lands are managed to meet the objectives and goals of the Settlement Agreement; this impact is considered **significant**.

Mitigation Measure LU-1 (Alternative C): ***Preserve Agricultural Productivity of Designated Farmland to the Extent Possible.*** Refer to Mitigation Measure LU-1 (Alternative A). The same mitigation measure would apply to this impact. Project proponents will recognize and minimize adverse effects on agricultural lands to the extent practicable, including modification of construction practices. However, this mitigation measure would not fully avoid the conversion of agricultural land to non-agricultural uses, and there are no additional measures to fully mitigate the loss of farmland; therefore, this impact would be **significant and unavoidable**.

Impact LU-2 (Alternative C): ***Conversion of Designated Farmland to Non-Agricultural Uses***. Compared to No-Action, Alternative C would result in the conversion of designated Farmland in the Project area to non-agricultural uses (see Table 16-9), namely the permanent removal of 939 acres of Prime Farmland, 163 acres of Farmland of Statewide Importance, and 116 acres Unique Farmland from agricultural production to accommodate the proposed levees, floodplain restoration, and Project structures. Similar to all Project alternatives, an additional 350 acres of land would be required for borrow material to support construction activities; however, the exact location of the borrow areas is not known, although it is likely to occur on Farmland, which comprises about 88 percent of potential borrow areas under Alternative C. Finally, during construction, an additional 81 acres of Farmland would be temporarily taken out of production, but could return to active agriculture once the Project is complete. In cases where farmland remains undeveloped (e.g., floodplain), the land would retain some of its agricultural value and long-term agricultural viability; however, because the proposed Reach 2B component of the Restoration Program is a long-term effort, these lands would not likely return to active crop production and are considered to be converted to non-agricultural uses.

When comparing Alternative C to existing conditions, impacts to designated farmland under the FMMP would be similar to those described in the preceding paragraph (i.e., the comparison of Alternative C to No-Action). In summary, the Project would remove Prime Farmland, Farmland of Statewide Importance, and Unique Farmland from production over both the short and long term; this impact is considered **significant**.

Mitigation Measure LU-2 (Alternative C): ***Preserve Agricultural Productivity of Designated Farmland to the Extent Possible.*** Refer to Mitigation Measure LU-1 (Alternative A). The same mitigation measure would apply to this impact. Project proponents will recognize and minimize adverse effects on agricultural lands to the extent practicable, including modification of construction practices. However, this mitigation measure would not fully avoid the conversion of agricultural land to non-agricultural uses, and there are no additional measures to fully mitigate the loss of farmland; therefore, this impact would be **significant and unavoidable**.

Impact LU-3 (Alternative C): *Conflict with Williamson Act Contracts*. Compared to No-Action, Alternative C would result in potential conflicts with Williamson Act contracts in effect on agricultural properties in the Project area. In total, approximately 173 acres under Williamson Act contract are located in areas underlying the proposed levee system and other Project facilities, 118 acres in areas subject to temporary disturbance during construction, and 1,211 acres in areas within the proposed floodplain. In addition, about 350 acres of land would serve as borrow areas that are likely to be under a Williamson Act contract.

Generally, land uses and improvements on lands enrolled in Williamson Act contracts are limited to commercial agriculture or uses determined to be compatible or incidental to commercial agriculture. However, Project infrastructure and habitat restoration areas are not considered compatible or incidental to agriculture.

Although conflicts with Williamson Act contracts are relative to existing contract provisions and portions of the Project area may be considered a “compatible use” under the Williamson Act, for the purpose of this analysis it is assumed that Williamson Act contracts would be canceled during land acquisition. Further, there would be no effect on existing agricultural landowners with respect to additional tax burdens.

When comparing Alternative C to existing conditions, impacts to Williamson Act contracts would be similar to those described in the preceding paragraph (i.e., the comparison of Alternative C to No-Action). In summary, long-term restoration activities that are not consistent or incidental to commercial agriculture would likely conflict with Williamson Act contracts in place in the Project area; this impact is considered **significant**.

Mitigation Measure LU-3 (Alternative C): ***Preserve Agricultural Productivity of Designated Farmland to the Extent Possible.*** Refer to Mitigation Measure LU-1 (Alternative A). The same mitigation measure would apply to this impact. Project proponents will recognize and minimize adverse effects on agricultural lands to the extent practicable, including modification of construction practices. However, this mitigation measure would not fully avoid the conversion of agricultural land to non-agricultural uses, and there are no additional measures to fully mitigate the loss of farmland; therefore, this impact would be **significant and unavoidable**.

Impact LU-4 (Alternative C): ***Degradation of Agricultural Land Productivity due to Seepage***. Under Alternative C, potential degradation of agricultural land productivity due to seepage would be the similar to that described under Alternative A as both alternatives propose a narrow floodplain; refer to Impact LU-4 (Alternative A) for details. Approximately 400 acres could be subject to groundwater levels less than 7 feet below ground surface and a 330-acre subset of that area would be subject to groundwater levels less than 5 feet below ground surface. Compared to the No-Action Alternative, where adverse effects to agricultural production in the Project area would be minimized by the Program's activities to control flow through the reach, Alternative C would have similar effects to agricultural productivity on lands potentially affected by seepage in the Project area because seepage effects would be minimized by seepage control measures included as Project actions.

Compared to existing conditions, where seepage effects occurred only during flood flow years in Reach 2B (instead of the potential for more frequent seepage issues with Restoration Flows), Alternative C could potentially have an adverse effect on agricultural productivity in the Project area due to the additional capacity for Restoration Flows which would occur every year. However, with the seepage-related measures integrated into the Project (see Section 2.2.4), this impact would be **less than significant**.

Impact LU-5 (Alternative C): ***Conflict with Applicable Land Use Plans Regarding Agricultural Lands***. Under Alternative C, potential conflicts with applicable land use plans would generally be the same as those described for Alternative A; refer to Impact LU-5 (Alternative A) for details. Compared to existing conditions, Alternative C would conflict with applicable land use plans, including the Fresno and Madera County zoning ordinances and general plans based on the conversion of agricultural land to other land uses; this impact is considered **potentially significant**.

Mitigation Measure LU-5 (Alternative C): ***Notify County Planning Agencies of General Plan and Zoning Ordinance Inconsistencies.*** Refer to Mitigation Measure LU-5 (Alternative A). The same mitigation measure would apply to this impact. Project proponents will recognize and minimize adverse effects on agricultural land use and zoning by notifying Fresno and Madera County planning agencies of any inconsistencies in designations and applicable polices for affected areas. By notifying affected planning agencies of conflicts with current land use plans, the significant impact can be reduced to **less than significant**.

Impact LU-6 (Alternative C): ***Diminishment of Agricultural Production by Increased Disease***. Compared to No-Action, additional riparian vegetation and floodplain area along the river could affect the incidence of some orchard and vineyard diseases on adjacent land by serving as a source of causal organisms. However, the additional sources of causal organisms that could result from implementing Alternative C would not substantially reduce agricultural activity for several reasons: disease-causing organisms could already occur on a variety of widely planted fruit and nut crops in the Project area, the incidence of disease is not solely or even primarily determined by the presence of causal organisms in the vicinity of an orchard or vineyard, and incidence of disease is only one of many factors affecting agricultural productivity.

When comparing Alternative C to existing conditions, impacts would be similar to those discussed in the preceding paragraph (i.e., the comparison of Alternative C to No-Action). This impact would be **less than significant**.

Alternative D (Fresno Slough Dam with Wide Floodplain and North Canal)

Similar to all of the Project alternatives, Alternative D proposes habitat restoration activities in conjunction with an expanded floodplain and widened levee alignments, as well as new Project facilities that promote fish passage through Reach 2B. Alternative D has a relatively wider floodplain configuration that is located across agricultural land. Alternative D includes passive riparian habitat restoration and farming in the floodplain. Similar to Alternatives A and B, agricultural uses that are suitable within the proposed floodplain would be allowed under Alternative D. Construction activity is expected to occur intermittently over an approximate 158-month timeframe.

Impact LU-1 (Alternative D): ***Removal of Land from Agricultural Production***. Compared to No-Action, Alternative D would result in the removal of land from agricultural production in the Project area. As shown in Table 16-7 above, there is approximately 4,208 acres of land in agricultural production in the footprint of Alternative D. Of this total, about 1,347 acres would be subject to permanent loss of agricultural production, which includes the area underlying the proposed levee alignments and structures, borrow areas, and passive riparian habitat restoration areas within the floodplain. In addition, another 69 acres of farmland would be temporarily disturbed during the 13-year construction period to accommodate features such as staging areas and access roads. Agricultural activity would be allowed on the floodplain within the proposed levee alignment (outside riparian habitat restoration areas) under Alternative D, up to 956 acres; however, because this area would be subject to frequent inundation, it is likely that agricultural activity would primarily be livestock grazing. Agricultural production on the remaining farmland within Alternative D, roughly 1,835 acres, would not be affected.

Table 16-12 shows agricultural effects by crop type. The Project would affect both permanent and annual crops, with the greatest impacts expected on almonds, which account for about 35 percent of the agricultural land that would be taken out of production permanently. Other crops that would be taken out of production on a long-term basis include row crops (18 percent of permanent agricultural losses), vacant agricultural land (15 percent), grapes (15 percent), and pistachios (11 percent).

Table 16-12.
Agricultural Effects by Crop Type, Alternative D

Crop Type	Type of Effect			
	Permanent Loss (acres)	Temporary Loss (acres)	Shift in Agricultural Activity (acres)	No Effect (acres)
Alfalfa	27	3	22	17
Almonds	493	1	308	1,167
Cotton	2	7	0	5
Grapes	205	20	71	323
Grazing	38	0	0	1
Other Row Crop	239	16	5	285
Palm	8	0	2	0
Pistachio	138	20	324	37
Agriculture-Vacant	197	1	225	0
Total	**1,347**	**69**	**956**	**1,835**

When comparing Alternative D to existing conditions (where there is no active habitat restoration in the Project area), impacts to agricultural land uses would be similar to those described in the preceding paragraphs (i.e., the comparison of Alternative D to No-Action). In summary, the Project would remove agricultural land from production over both the short term (i.e., during construction) and long term (i.e., into perpetuity) as lands are managed to meet the objective and goals of the Settlement Agreement; this impact is considered **significant**.

Mitigation Measure LU-1 (Alternative D): ***Preserve Agricultural Productivity of Designated Farmland to the Extent Possible.*** Refer to Mitigation Measure LU-1 (Alternative A). The same mitigation measure would apply to this impact. Project proponents will recognize and minimize adverse effects on agricultural lands to the extent practicable, including modification of construction practices. However, this mitigation measure would not fully avoid the conversion of agricultural land to non-agricultural uses, and there are no additional measures to fully mitigate the loss of farmland; therefore, this impact would be **significant and unavoidable**.

Impact LU-2 (Alternative D): ***Conversion of Designated Farmland to Non-Agricultural Uses***. Compared to No-Action, Alternative D would result in the conversion of designated Farmland in the Project area to non-agricultural uses (see Table 16-9).

Specifically, Alternative D would permanently remove 917 acres of Prime Farmland, 112 acres of Farmland of Statewide Importance, and 113 acres Unique Farmland from agricultural production to accommodate the proposed levees, floodplain restoration, and other Project structures. An additional 350 acres of land would be required for borrow material to support construction activities; however, the exact location of the borrow areas is not known, although it is likely to occur on Farmland, which comprises about 86 percent of potential borrow areas under Alternative D. During construction, another 77 acres of Farmland would be temporarily taken out of production, but could return to active agriculture once the Project is complete. Lastly, approximately 862 acres of Farmland is located within the proposed floodplain, which would be available for agricultural activity (likely livestock grazing) under Alternative D. With some of the Project features, particularly where farmland remains undeveloped, the land would retain some of its agricultural value and long-term agricultural viability; however, because the proposed Reach 2B component of the Restoration Program is a long-term effort, these lands would not likely return to active crop production and are considered to be converted to non-agricultural uses.

When comparing Alternative D to existing conditions, impacts to designated farmland under the FMMP would be similar to those described in the preceding paragraph (i.e., the comparison of Alternative D to No-Action). In summary, the Project would remove Prime Farmland, Farmland of Statewide Importance, and Unique Farmland from production over both the short and long term; this impact is considered **significant**.

Mitigation Measure LU-2 (Alternative D): ***Preserve Agricultural Productivity of Designated Farmland to the Extent Possible.*** Refer to Mitigation Measure LU-1 (Alternative A). The same mitigation measure would apply to this impact. Project proponents will recognize and minimize adverse effects on agricultural lands to the extent practicable, including modification of construction practices. However, this mitigation measure would not fully avoid the conversion of agricultural land to non-agricultural uses, and there are no additional measures to fully mitigate the loss of farmland; therefore, this impact would be **significant and unavoidable**.

Impact LU-3 (Alternative D): *Conflict with Williamson Act Contracts*. Compared to No-Action, implementation of Alternative D would result in potential conflicts with Williamson Act contracts in place on agricultural properties in the Project area. In total, approximately 551 acres under Williamson Act contract are located in areas underlying the proposed levee system and other Project facilities, 104 acres in areas subject to temporary disturbance during construction, and 1,635 acres within the proposed floodplain. In addition, about 350 acres of land would serve as borrow areas that are likely to be under a Williamson Act contract.

Generally, land uses and improvements on lands enrolled in Williamson Act contracts are limited to commercial agriculture or uses determined to be compatible or incidental to commercial agriculture. Project infrastructure (e.g., the proposed levee system and other facilities) and habitat restoration areas are not considered compatible or incidental to agriculture. However, under Alternative D, agricultural activity (likely livestock grazing) would be allowed on lands within the proposed floodplain (outside riparian and floodplain habitat restoration areas); livestock grazing would likely be consistent with Williamson Act contracts in effect on these lands.

Although conflicts with the Williamson Act are relative to existing contract provisions and portions of the Project area may be considered a “compatible use” under the Williamson Act, for the purpose of this analysis it is assumed that Williamson Act contracts would be canceled during land acquisition. Further, there would be no effect on existing agricultural landowners with respect to additional tax burdens.

When comparing Alternative D to existing conditions, impacts to Williamson Act contracts would be similar to those described in the preceding paragraph (i.e., the comparison of Alternative D to No-Action). In summary, long-term restoration activities that are not consistent or incidental to commercial agriculture would likely conflict with Williamson Act contracts in place in the Project area; this impact is considered **significant**.

Mitigation Measure LU-3 (Alternative D): ***Preserve Agricultural Productivity of Designated Farmland to the Extent Possible.*** Refer to Mitigation Measure LU-1 (Alternative A). The same mitigation measure would apply to this impact. Project proponents will recognize and minimize adverse effects on agricultural lands to the extent practicable, including modification of construction practices. However, this mitigation measure would not fully avoid the conversion of agricultural land to non-agricultural uses, and there are no additional measures to fully mitigate the loss of farmland; therefore, this impact would be **significant and unavoidable**.

Impact LU-4 (Alternative D): ***Degradation of Agricultural Land Productivity due to Seepage***. Under Alternative D, potential degradation of agricultural land productivity due to seepage would be similar to that described under Alternative B as both alternatives include a wider floodplain; refer to Impact LU-4 (Alternative B) for details. Approximately 400 acres could be subject to groundwater levels less than 7 feet below ground surface and a 330-acre subset of that area would be subject to groundwater levels less than 5 feet below ground surface. Compared to the No-Action Alternative, where adverse effects to agricultural production in the Project area would be minimized by the Program’s activities to control flow through the reach, Alternative D would have similar effects to agricultural productivity on lands potentially affected by seepage in the Project area because seepage effects would be minimized by seepage control measures included as Project actions.

Compared to existing conditions, where seepage effects occurred only during flood flow years in Reach 2B (instead of the potential for more frequent seepage issues with Restoration Flows), Alternative D could potentially have an adverse effect on agricultural productivity in the Project area due to the additional capacity for Restoration Flows which would occur every year. However, with the seepage-related measures integrated into the Project (see Section 2.2.4), this impact would be **less than significant**.

Impact LU-5 (Alternative D): ***Conflict with Applicable Land Use Plans Regarding Agricultural Lands***. Under Alternative D, potential conflicts with applicable land use plans would generally be the same as those described for Alternative A; refer to Impact LU-5 (Alternative A) for details. Compared to existing conditions, Alternative D would conflict with applicable land use plans, including the Fresno and Madera County zoning ordinances and general plans based on the conversion of agricultural land to other land uses; this impact is considered **potentially significant**.

Mitigation Measure LU-5 (Alternative D): ***Notify County Planning Agencies of General Plan and Zoning Ordinance Inconsistencies.*** Refer to Mitigation Measure LU-5 (Alternative A). The same mitigation measure would apply to this impact. Project proponents will recognize and minimize adverse effects on agricultural land use and zoning by notifying Fresno and Madera County planning agencies of any inconsistencies in designations and applicable polices for affected areas. By notifying affected planning agencies of conflicts with current land use plans, the significant impact can be reduced to **less than significant**.

Impact LU-6 (Alternative D): ***Diminishment of Agricultural Production by Increased Disease***. Compared to No-Action, additional riparian vegetation and floodplain area along the river could affect the incidence of some orchard and vineyard diseases on adjacent land by serving as a source of causal organisms. However, the additional sources of causal organisms that could result from implementing Alternative D would not substantially reduce agricultural activity for several reasons: disease-causing organisms could already occur on a variety of widely planted fruit and nut crops in the Project area, the incidence of disease is not solely or even primarily determined by the presence of causal organisms in the vicinity of an orchard or vineyard, and incidence of disease is only one of many factors affecting agricultural productivity.

When comparing Alternative D to existing conditions, impacts would be similar to those discussed in the preceding paragraph (i.e., the comparison of Alternative D to No-Action). This impact would be **less than significant**.

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