U.S. Department of the Interior
Bureau of Reclamation
Mid-Pacific Region

RECORD OF DECISION

MENDOTA POOL BYPASS AND REACH 2B IMPROVEMENTS PROJECT

ATTACHMENTS

ATTACHMENT A – PROJECT DESCRIPTION

ATTACHMENT B – ENVIRONMENTAL COMMITMENT PLAN AND TRACKING PROGRAM

ATTACHMENT C – PROGRAMMATIC AGREEMENT

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ATTACHMENT A:
Project Description

1.0 Introduction

In 1988, a coalition of environmental groups, led by the Natural Resources Defense Council (NRDC) filed a lawsuit, known as *NRDC, et al., v. Kirk Rodgers, et al.*, challenging the renewal of long-term water service contracts between the United States and the Central Valley Project Friant Division contractors. On September 13, 2006, after more than 18 years of litigation, the Settling Parties, including NRDC, Friant Water Authority, and the U.S. Departments of the Interior and Commerce, agreed on terms and conditions for a Settlement. The Settlement establishes two primary goals:

- **Restoration Goal** – To restore and maintain fish populations in "good condition" in the main stem San Joaquin River below Friant Dam to the confluence of the Merced River, including naturally reproducing and self-sustaining populations of salmon and other fish.
- **Water Management Goal** – To reduce or avoid adverse water supply impacts on all of the Friant Division long-term contractors that may result from the Interim and Restoration flows provided for in the Settlement.

The Settlement establishes a framework for accomplishing the Restoration and Water Management goals that will require environmental compliance, design, construction, and monitoring of projects over a multiple-year period. To achieve the Restoration Goal, the Settlement calls for a combination of channel and structural modifications along the San Joaquin River below Friant Dam, releases of water from Friant Dam to the confluence of the Merced River (referred to as Interim and Restoration flows), and reintroduction of Chinook salmon. To achieve the Water Management Goal, the Settlement calls for recirculation, recapture, reuse, exchange or transfer of the Interim and Restoration flows to reduce or avoid impacts to water deliveries to all of the Friant Division long-term contractors caused by the Interim and Restoration flows.

The San Joaquin River Restoration Program (SJRRP) is the program established to implement the Settlement. Implementing agencies responsible for managing and implementing the SJRRP are U.S. Department of the Interior, Bureau of Reclamation (Reclamation), U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), the California Department of Water Resources (DWR), and California Department of Fish and Wildlife (DFW). The San Joaquin River Restoration Settlement Act (Settlement Act), included in Public Law 111-11, the Omnibus Public Lands Management Act of 2009, authorizes and directs the Secretary of the Interior to implement the terms and conditions of the Settlement. The anticipated benefits and potential impacts of implementing the SJRRP were analyzed in the Program Environmental Impact Statement/Environmental Impact Report (PEIS/R) (SJRRP 2011a).

The SJRRP's Restoration Area includes a 153–mile section of the San Joaquin River from Friant Dam to the confluence with the Merced River in Fresno and Madera counties, California. The SJRRP's Restoration Area is divided into separate reaches (Figure 1-1). In order to implement the SJRRP, a comprehensive strategy for the conservation of listed and sensitive species and habitats—termed the Conservation Strategy—was prepared in coordination with the Implementing Agencies.

The Mendota Pool Bypass and Reach 2B improvements are defined in the Settlement (Settlement Paragraph 11[a]):

> *(1) Creation of a bypass channel around Mendota Pool to ensure conveyance of at least 4,500 cubic feet per second (cfs) from Reach 2B downstream to Reach 3. This improvement requires construction of a structure capable of directing flow down the bypass and allowing the Secretary to make deliveries of San Joaquin River water into Mendota Pool when necessary;*
>
> *(2) Modifications in channel capacity (incorporating new floodplain and related riparian habitat) to ensure conveyance of at least 4,500 cfs in Reach 2B between the Chowchilla Bifurcation Structure and the new Mendota Pool bypass channel.*

Since the functions of these channels may be interrelated, the design, environmental compliance, and construction of the two are being addressed as one project. The Project would be implemented consistent with the Settlement and the Settlement Act. See Figures 1-2 and 1-3 for a plan view of the Project's features.

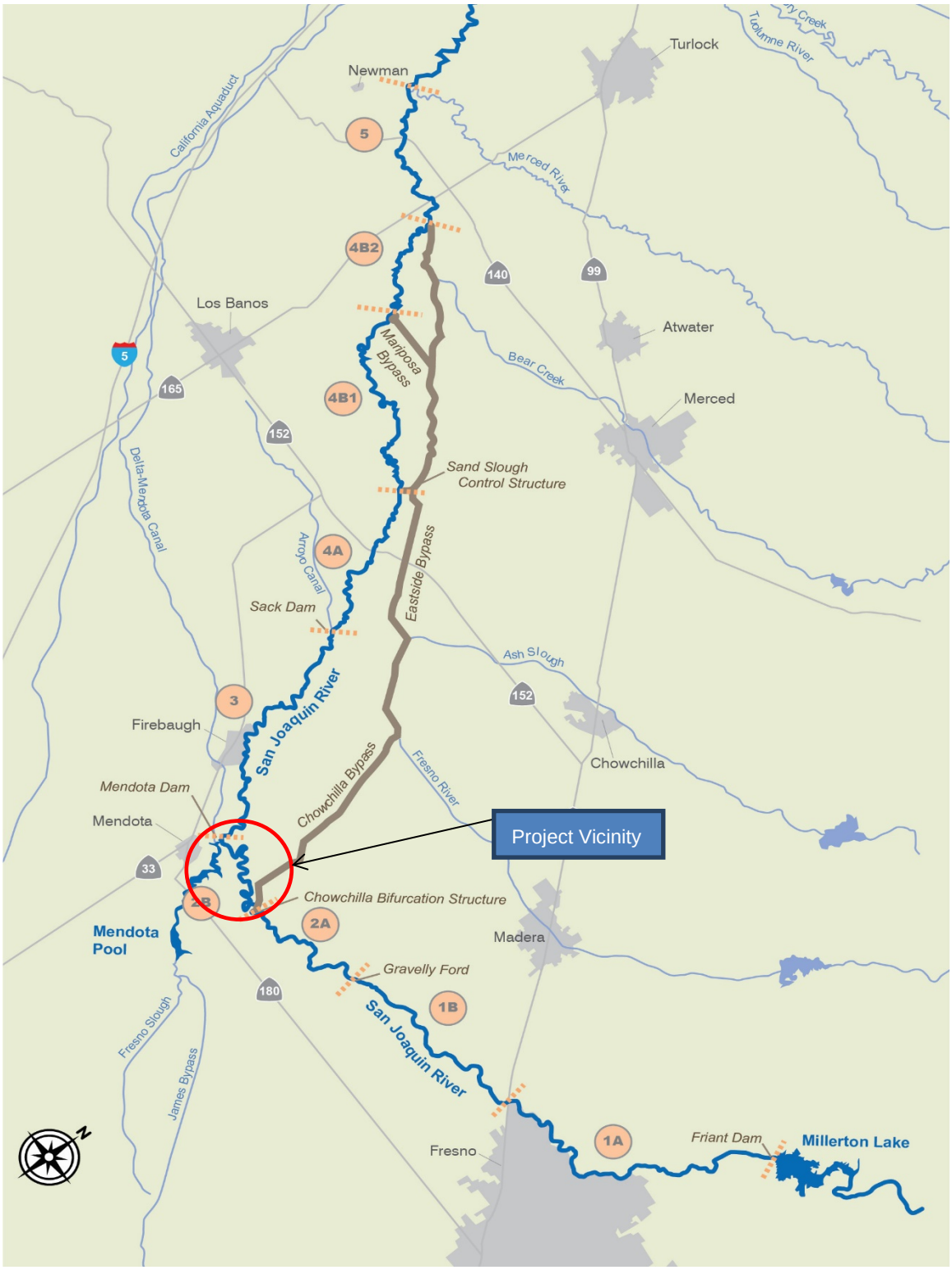


Figure 1-1.
Overview of the SJRRP Restoration Area and the Project Vicinity

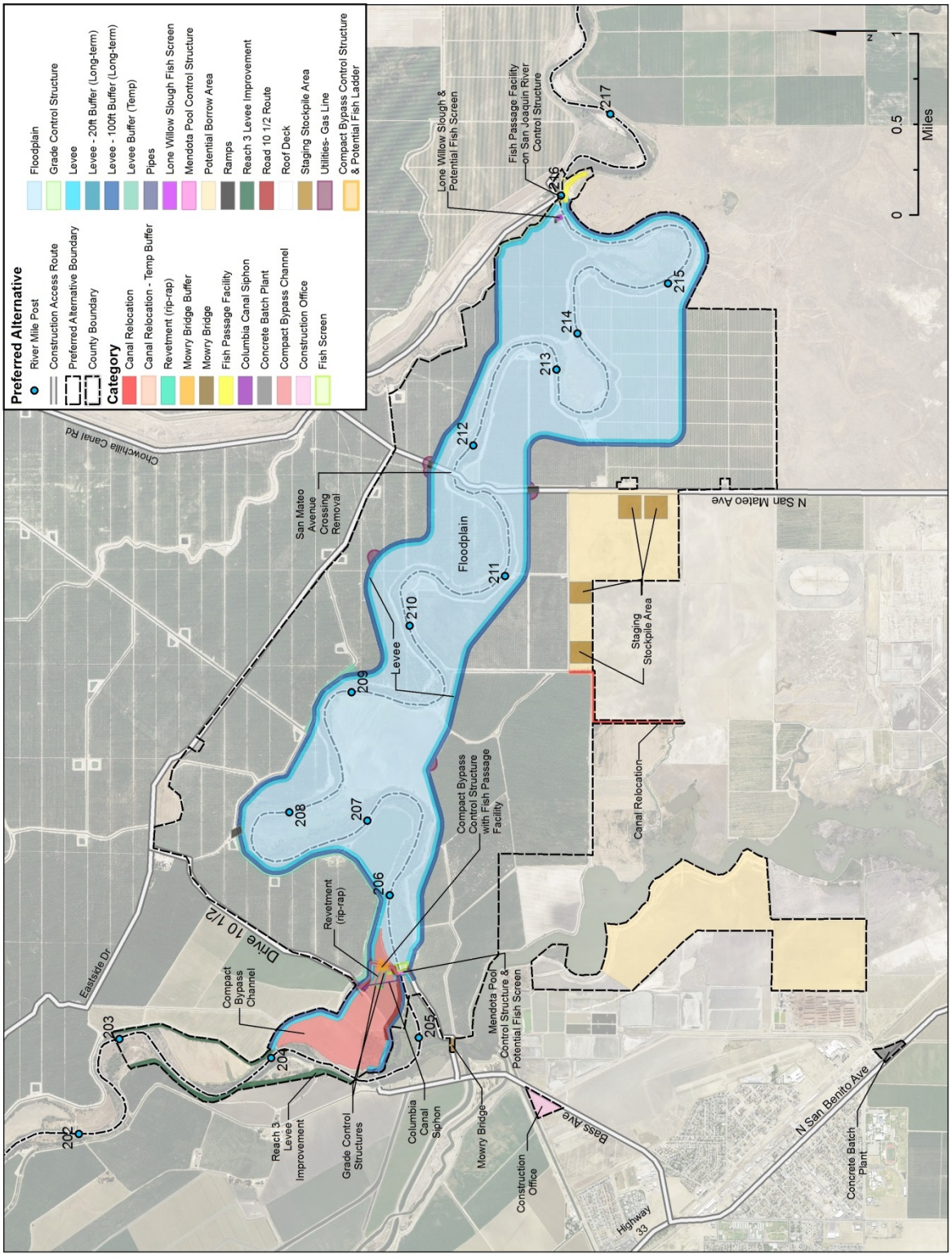


Figure 1-2.
Plan View of Project

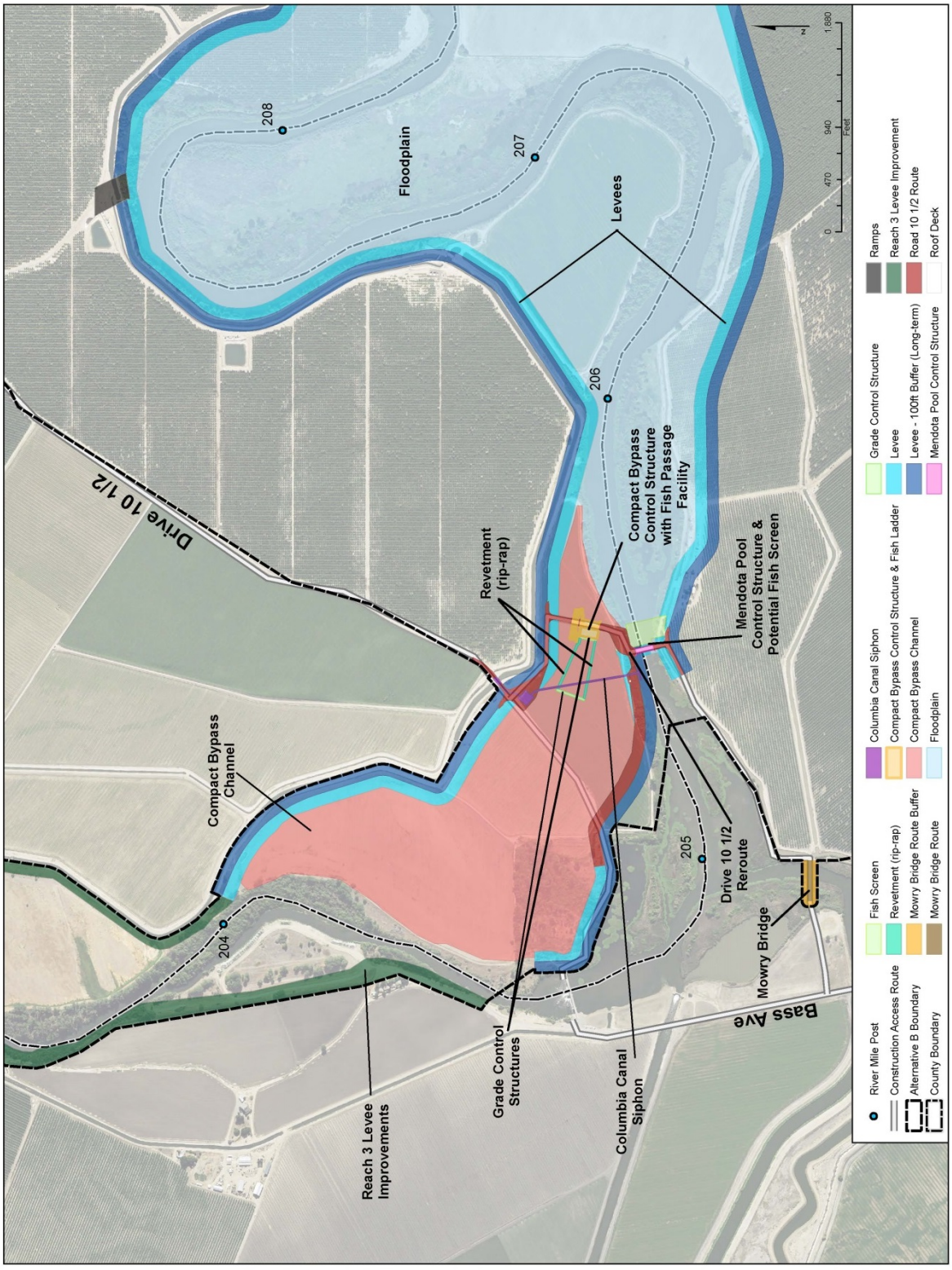


Figure 1-3.
Inset Map of Project

2.0 Project Description

The Project consists of a floodplain width which passes 4,500 cfs, a method to bypass Restoration Flows around Mendota Pool, and a method to deliver water to Mendota Pool. The Project complies with the terms of the Settlement, substantially meets the Project goals and objectives, and has benefits offsetting its impacts. Elements of the Project include:

- Building setback levees capable of conveying flows up to 4,500 cfs with 3 feet of freeboard, and breaching portions of the existing levees.
- Restoring floodplain habitat with an average width of approximately 4,200 feet to provide benefit to salmonids and other native fishes.
- Constructing a channel and structures capable of conveying up to 4,500 cfs of Restoration Flows around the Mendota Pool.
- Constructing structures capable of conveying up to 2,500 cfs from Reach 2B to Mendota Pool.
- Providing upstream and downstream fish passage for adult salmonids and other native fishes, and downstream fish passage for juvenile salmonids, between Reach 2A and Reach 3.

The Project would construct a channel between Reach 2B and Reach 3, the Compact Bypass channel, in order to bypass the Mendota Pool. Restoration Flows would enter Reach 2B at the Chowchilla Bifurcation Structure, flow through Reach 2B, then downstream to Reach 3 via the Compact Bypass channel. The existing Chowchilla Bifurcation Structure would continue to divert San Joaquin River flows into the Chowchilla Bypass during flood operations, and a fish passage facility and control structure modifications would be included at the San Joaquin River control structure at the Chowchilla Bifurcation Structure. This action would also include constructing two new structures in Reach 2B, the Compact Bypass Control Structure and the Mendota Pool Control Structure (collectively referred to as the Compact Bypass structures), to divert up to 2,500 cfs to the Mendota Pool. Fish passage facilities would be built at the Compact Bypass Control Structure to provide passage around the structure when gates are closed during times of water delivery. Most of the time, fish would pass through the Compact Bypass Control Structure into the bypass channel and gates would be closed on the Mendota Pool Control Structure, preventing fish entrainment to the Mendota Pool. A fish screen would be built at the Mendota Pool Control Structure to prevent fish being entrained in the diversion. The existing crossing at the San Mateo Avenue would be removed. These features are described in further detail in the sections below. See Figure 1-2 and Figure 1-3 for a plan view of the Project's features.

2.1 Compact Bypass Channel

The bypass channel would convey 4,500 cfs around the Mendota Pool by constructing a channel just southwest of the existing Columbia Canal alignment. Once constructed, the bypass channel would become the new river channel. The Project includes excavating the bypass channel, constructing setback levees and in-channel structures, breaching existing levees but leaving some segments that provide valuable habitat in place, relocating or modifying existing infrastructure, and acquiring land. The in-channel structures include the Compact Bypass Control Structure,

Mendota Pool Control Structure, grade control structures, fish screen, fish passage facility at the Compact Bypass Control Structure, Columbia Canal siphon and pumping plant, as well as the Drive 10 ½ realignment and are discussed under Structures. The bypass channel and associated structures provide downstream passage of juvenile Chinook salmon and upstream passage of adult Chinook salmon, as well as passage for other native fishes, while isolating Mendota Pool from Restoration Flows.

The bypass channel would connect to Reach 3 approximately 0.6 mile downstream from Mendota Dam (approximately RM 204), bypass the Mendota Pool to the north, and connect to Reach 2B approximately 0.9 mile upstream from Mendota Dam (approximately RM 205.5). The bypass channel would have a total length of approximately 0.8 mile. A siphon under the bypass channel would be constructed to connect the Columbia Canal to the Mendota Pool.

The bypass channel would be a multi-stage channel designed to facilitate fish passage at low flows, channel stability at moderate flows, and contain high flows. The low flow channel is approximately 70 feet wide and has an average depth of approximately 3 feet deep. It is designed to contain approximately 200 cfs (Figure 2-1 and Figure 2-2), and is sinuous. The overbank slopes toward the low flow channel. The bank slope is 67 feet horizontal to 1 foot (67H:1V) and a flow of 1200 cfs is designed to have about 1 foot of depth in the overbank. The overbank slope increases to 20H:1V at a distance of 135 feet from the center of the channel. The floodplain is intended to produce a range of channel depths regardless of the flow.

The elevation of the Compact Bypass Control Structure is set at 141 feet in order to promote sediment stability throughout Reaches 2 and 3 and minimize the need for grade control in the Compact Bypass channel. Because the entrance to the bypass is located approximately 7 feet below the current thalweg of Reach 2B, a pilot channel will be constructed to create a smoother transition between Reach 2B and the bypass channel (Figure 2-3; shown in red) and reduce sedimentation downstream into Reach 3. The pilot channel will be a 70-foot-wide channel with 2H:1V side slopes. It will be excavated within Reach 2B, upstream of the junction between the bypass and San Joaquin River. The excavation will be performed just prior to the reintroduction of high flows to the bypass so that sediment does not refill the channel. Some of the material excavated from the pilot channel could be placed in the bed of the low flow channel located in the bypass to a maximum depth of 1 foot.

The Compact Bypass channel, designed as an unlined earthen channel, would be approximately 4,000 feet long with a total corridor width of approximately 510 feet. The average slope of the channel would be approximately 0.0005 (approximately 2.6 feet per mile), while the total elevation drop in the Compact Bypass after channel stabilization would be approximately 2 feet. Two grade-control structures just downstream of the Compact Bypass Control Structure would be included to achieve the necessary elevation change (see Grade Control Structures). Channel complexity is incorporated as appropriate per the Rearing Habitat Design Objectives (SJRRP 2014).

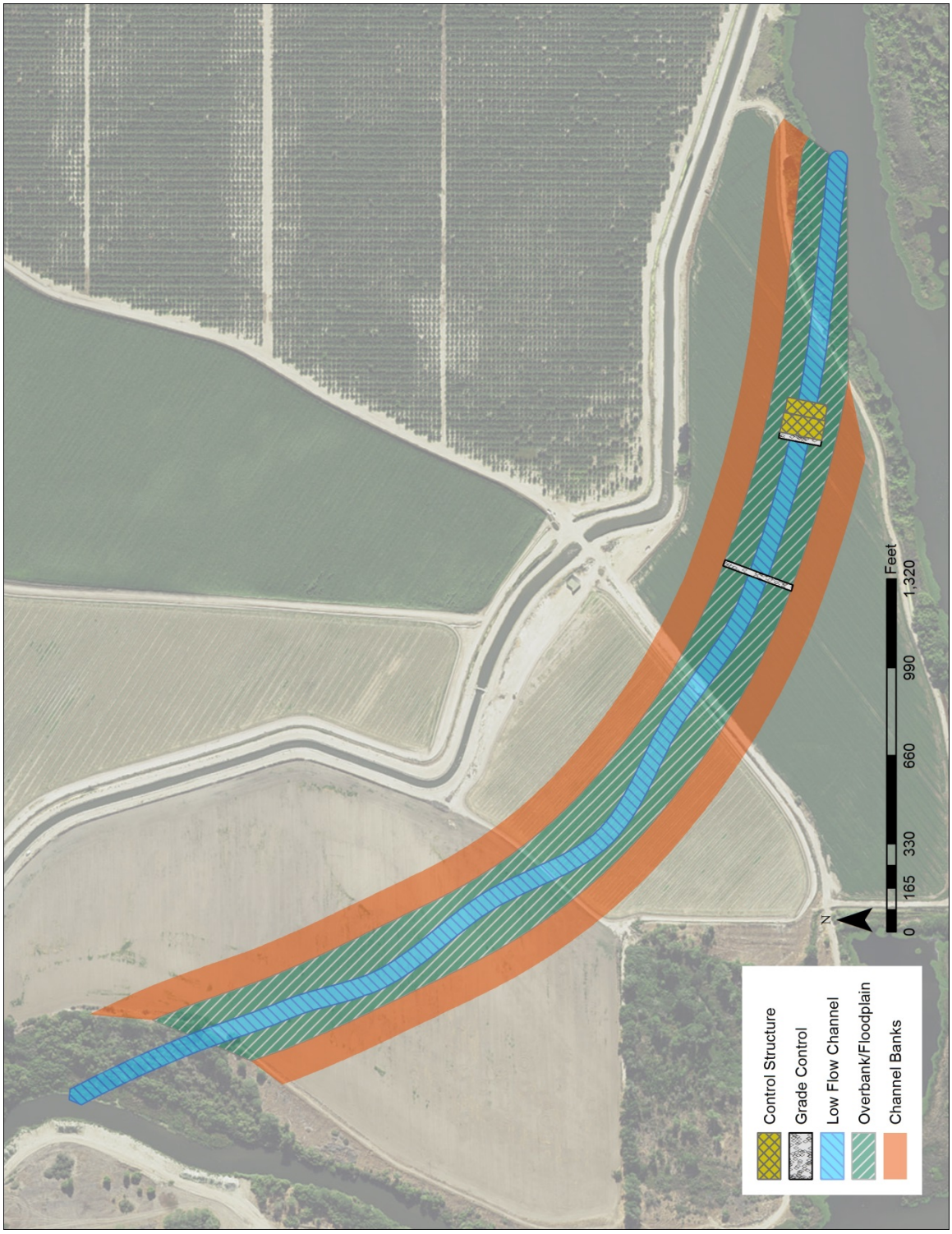


Figure 2-1.
Plan View of Compact Bypass

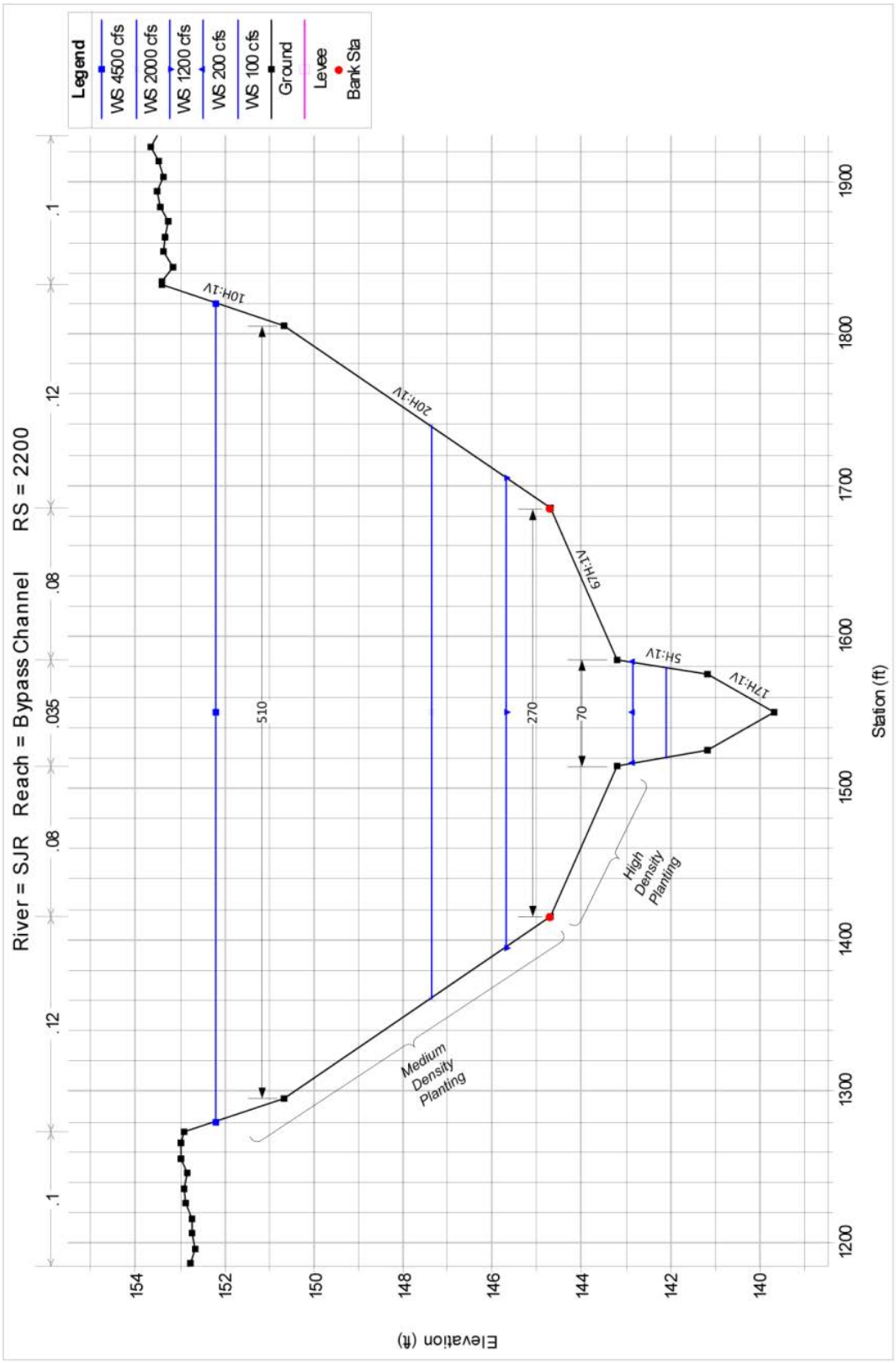


Figure 2-2.
Typical Cross Section in Compact Bypass

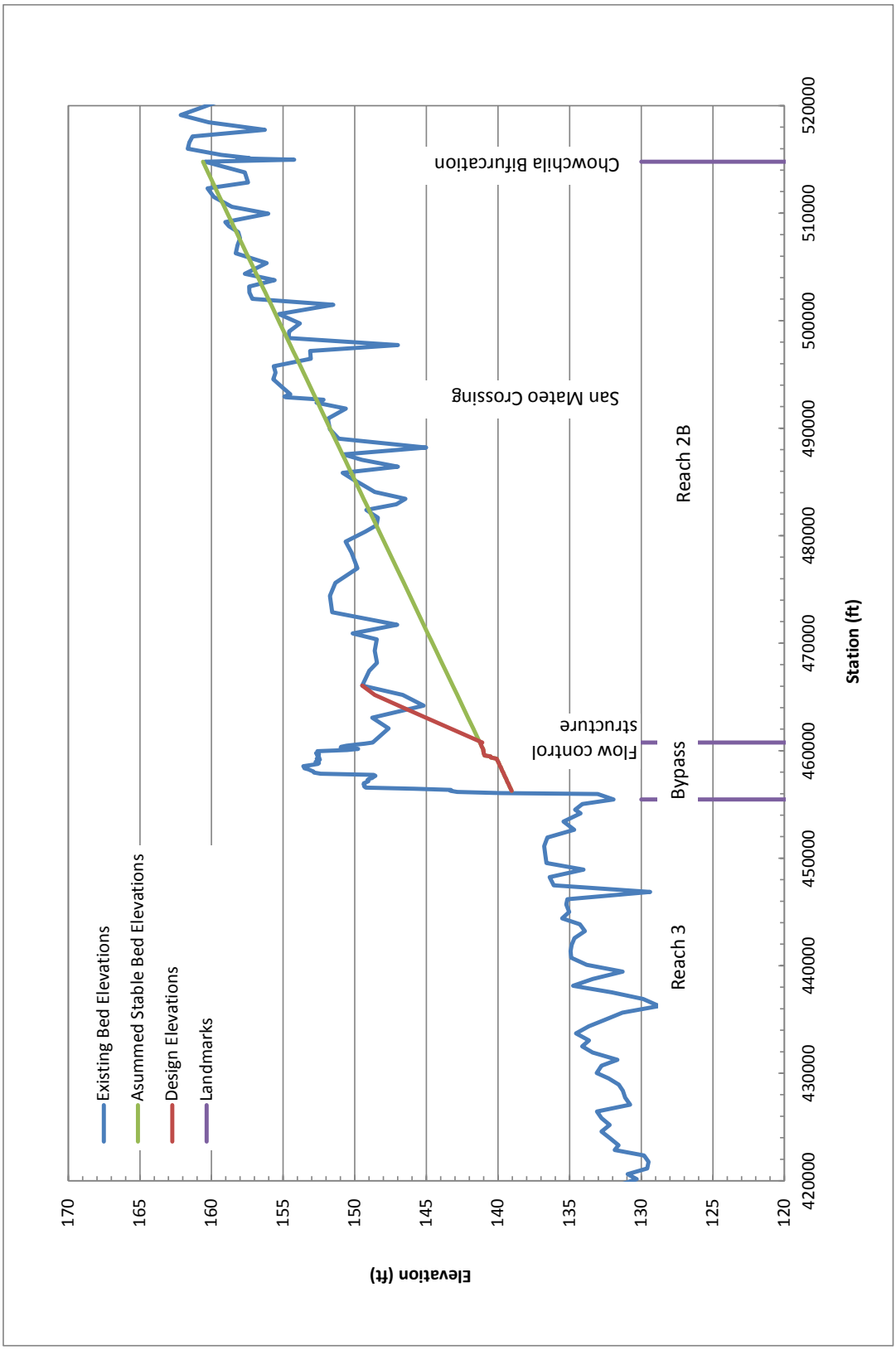


Figure 2-3.
Existing and Design Profiles in Reach 2B through the Compact Bypass

2.2 Structures

The structures described below would be required to provide the operational flexibility to divert water to the Mendota Pool, provide fish passage, allow maintenance access to Mendota Dam, prevent fish entrainment and straying, and provide controlled elevation drop between Reach 2B and Reach 3.

2.2.1 Fish Passage Facility on the San Joaquin River Control Structure at the Chowchilla Bifurcation Structure

The existing San Joaquin River control structure at the Chowchilla Bifurcation Structure would not be passable by up-migrating salmon and native fish for all flows and flow splits between the river and the Chowchilla Bypass. The undershot gates, sill across the downstream side of the structure, and trash rack on the upstream side contribute to upstream passage difficulties at high, low, and all flows, respectively. A fish passage facility would be required for upmigrating salmon and other native fish to swim into Reach 2A from Reach 2B under most conditions.

Passage Facility Design

The design of the fish passage facility would be based on criteria in Anadromous Salmonid Passage Facility Design (NMFS 2008). The size and geometry of the fish passage facility would be dictated by the flow requirements for juvenile and adult fish (see Final EIS/R Table 2.1). Several types of fish passage facilities may be considered in detailed design: vertical slot weir ladder design was included for its ability to accommodate a greater range of water depths (hydraulic head at the upstream and downstream ends), but the design may also consider ice-harbor, pool and chute, rock ramp fishway, or other passage facility designs.

A roadway would need to be built over the fish passage facility to connect the maintenance road atop the river control structure with the levee road on the south side of the river. The roadway would be supported by the vertical concrete walls of the fish passage facility or other structural features.

The fish passage facility would also be designed to not restrict or impede flows through the associated, adjacent control structure, including flood flows.

Attraction Flows

The attraction flow magnitude will be 5 to 10 percent of the total flow through the control structure over the path of Restoration Flows. The Project requires conveyance of at least 4,500 cfs, so the attraction flow at the passage facility entrance could be as high as 450 cfs. The passage facility itself may have a design flow rate less than the maximum attraction flow. In this case, the balance of attraction flows could be provided at the passage facility entrance (downstream side) through supplementary water, described below.

Supplementary Water

Supplementary water, if incorporated into the facility, is water already in the river and which is piped to the fish passage facility entrance to augment attraction flows (see Figure 2-4). No additional water supply beyond what would be flowing in the river is required. The supplementary water allows the passage facility to operate under a wider range of river flows by supplying additional attraction flow when the need exceeds the design flow rate through the passage facility. Supplementary water would also be used to control the hydraulic head at the

passage facility entrance. Supplementary flow would be collected by a water delivery intake structure located upstream from the fish passage facility. The intake structure would include a trash rack and a fish screen, if appropriate, to prevent migrating fish from entering the intake. River water would enter the intake structure, and travel downriver through pipes to the passage facility entrance.

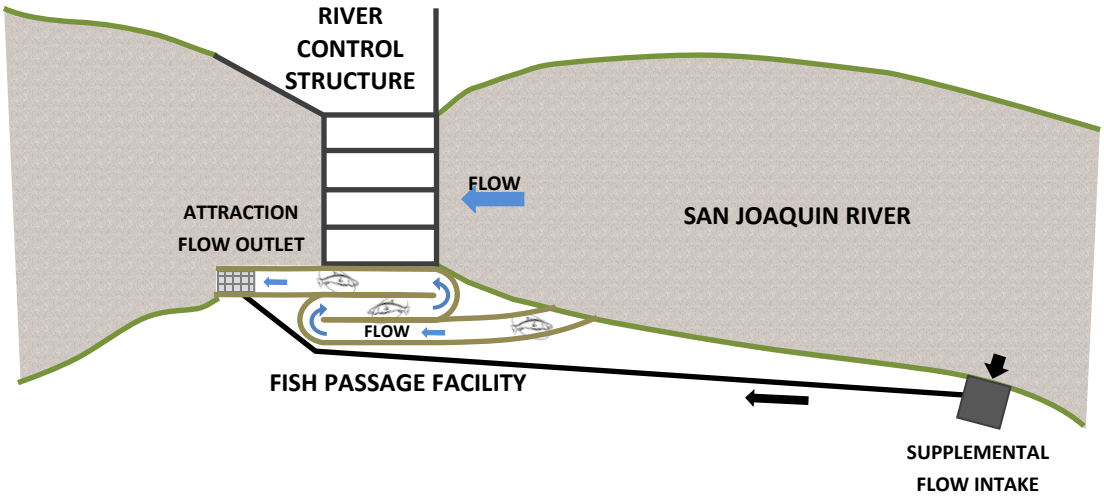


Figure 2-4.
Supplementary Flow System Plan-view Diagram

2.2.2 San Joaquin River Control Structure at the Chowchilla Bifurcation Structure Modifications

In addition to the passage facility, the San Joaquin River control structure at the Chowchilla Bifurcation Structure would be modified to improve fish passage through the control structure itself or to improve operations of the passage facility. Fish passage through the modified river control structure may meet passage criteria only for certain flows, so the fish passage facility described above would still be required.

Improvements to the river control structure could include removing the trash racks, replacing one or more radial gates with over-shot gates (e.g., inflatable Obermeyer weir gates), notching or removal of the baffle wall or weir, removing the dragon's teeth, and replacing or modifying the scour protection. Improvements would be designed based on NMFS 2001 and NMFS 2008 passage criteria. Improvements would not affect the ability of the structure to divert flood water into the Chowchilla Bypass.

2.2.3 San Mateo Avenue Crossing Removal

The San Mateo Avenue crossing is an existing river crossing located within a public right-of-way in Madera County and on private land in Fresno County at approximately RM 211.8. The crossing transitions from public right-of-way to private land at the center of the river. The crossing consists of a low flow or dip crossing with a single culvert. As part of the Project, the culvert and road embankments would be demolished, and no river crossing would be provided at this location.

2.2.4 Compact Bypass Structures

Two control structures would be constructed at the upstream end of the Compact Bypass: one across the path of Restoration Flows (Compact Bypass), also known as the Compact Bypass Control Structure, and one across the path of water deliveries to Mendota Pool (San Joaquin River), also known as the Mendota Pool Control Structure. The Compact Bypass Control Structure includes a fish passage facility on the side of the structure (i.e., the Compact Bypass Fish Passage Facility), and the Mendota Pool Control Structure would include a fish screen upstream of the structure (i.e., the Mendota Pool Fish Screen). Each control structure would be placed in the middle of the channel and has earthen embankments, which are designed as dams as they may have water on both sides, connecting the structure to the proposed levees. A 16-foot-wide roadway and 20-foot-wide maintenance/operations platform would be provided over each control structure.

Compact Bypass Control Structure

The Compact Bypass Control Structure would be designed to accommodate up to 4,500 cfs and would consist of eight 14-foot-wide bays. Conditions in this control structure would be designed based on the *Guidelines for Salmonid Passage at Stream Crossings* (NMFS 2001) and *Anadromous Salmonid Passage Facility Design* (NMFS 2008) fish passage criteria. The bays would be outfitted with radial gates. Approximately 95 percent of the time, fish and Restoration Flow would pass through this structure and all gates would be open.

When deliveries to Mendota Pool are occurring, most of the gates of the Compact Bypass Control Structure would be shut nearly all the way. The water surface elevation would increase by several feet on the upstream side of the structure. The gates of the Mendota Pool Control Structure would open and water would be delivered to Mendota Pool. In the delivery situation, fish and Restoration Flows would pass primarily through the fish passage facility, described below. Water that passes through the Compact Bypass Control Structure would be forced through a small opening, and a hydraulic jump would form downstream of the structure. A stilling basin would be located on the downstream side of the Compact Bypass Control Structure to contain the hydraulic jump that would form when deliveries are occurring to Mendota Pool.

Mendota Pool Control Structure

The control structure across the San Joaquin River (the path of the water deliveries) would be designed to accommodate up to 2,500 cfs. The structure would have twelve bays that are 10 feet wide, and would contain slide gates to control the flow of water rather than radial gates, since Mendota Pool would be impounded on the downstream side of the structure at all times. Guides for stop logs would be provided in all bays to allow for maintenance. A five foot barrier wall would be provided that could be added to the upstream side of the structure in several decades, to allow continued operation with subsidence.

2.2.5 Compact Bypass Fish Passage Facility

The Compact Bypass Control Structure (across the Restoration Flow path) includes a fish passage facility. The fish passage facility would be necessary to provide passage during water deliveries. The design of the fish passage facility is a vertical slot ladder with a sloped bottom, with approximately 12H:1V slope, 12 feet of drop across the fish passage facility, and approximately 3 feet of flow depth. Fish would only pass through this facility when deliveries are occurring to Mendota Pool, approximately 5 percent of the time when fish could be present.

Approximately 95 percent of the time, fish would migrate through the Compact Bypass Control Structure bays under the open gates.

2.2.6 Drive 10 ½ Crossing

The Compact Bypass channel would cross existing Drive 10 ½, which provides access for the operations and maintenance of Mendota Dam. To continue the current level of access, the road would be rerouted along the bypass channel levees and cross the head of the bypass channel at the proposed Compact Bypass Control Structure. A road deck would also be provided over the fish passage facility adjacent to the control structure. The road would be designed for HS-20/HL-93 loading (e.g., sufficient to allow transport of a 25-ton maintenance crane to Mendota Dam).

2.2.7 Columbia Canal Facilities

The Columbia Canal water intake facility would be located in Mendota Pool, and likely would consist of eight 15-foot-wide, 7-foot-tall bays, with a bar screen to prevent aquatic vegetation entering the siphon. The extensive intake area would be required to maintain appropriate velocities and minimize sediment and vegetation issues. Intake bays would be 7 feet tall to account for 5 feet of subsidence. Existing water surface elevations in Mendota Pool would rise to approximately 2 feet above the intake crest elevation. The bar screen would be cleaned by an automatic trash rake. A sediment sump would be provided in the center bay to allow for sediment removal. The top of the intake facility would be covered with grating to allow for easy access for maintenance. The Columbia Canal siphon would cross underneath the Compact Bypass channel from the intake facility on Mendota Pool to the pumping plant located near the existing Columbia Canal, approximately 1,000 feet. The siphon would be two adjacent 4-foot by 6-foot concrete box culverts, that would be buried a minimum of 5 feet below the low flow channel in the Compact Bypass. The discharge facility for the Columbia Canal siphon would be located where Drive 10 ½ crosses the Columbia Canal, on the north side of the future Compact Bypass (Figure 2-5). The pumping plant would be located adjacent to this facility.

The Columbia Canal intake facility and pumping plant would be constructed with SCADA (supervisory control and data acquisition) capability, but able to be manually operated as well. The pumping plant would include a steel plate door and cinder block walls and would be enclosed within a fenced and gated area to minimize vandalism.

Electronics Building

A separate, approximately 12-foot by 10-foot, electronics building would house power controls for trash rack cleaning systems, fish monitoring equipment, SCADA, etc. The building would be located adjacent to the Columbia Canal pumping plant, or on the other side of the Compact Bypass near the Mendota Pool Control Structure. The building would include a steel plate door and cinder block walls and would be enclosed within a fenced and gated area to minimize vandalism.

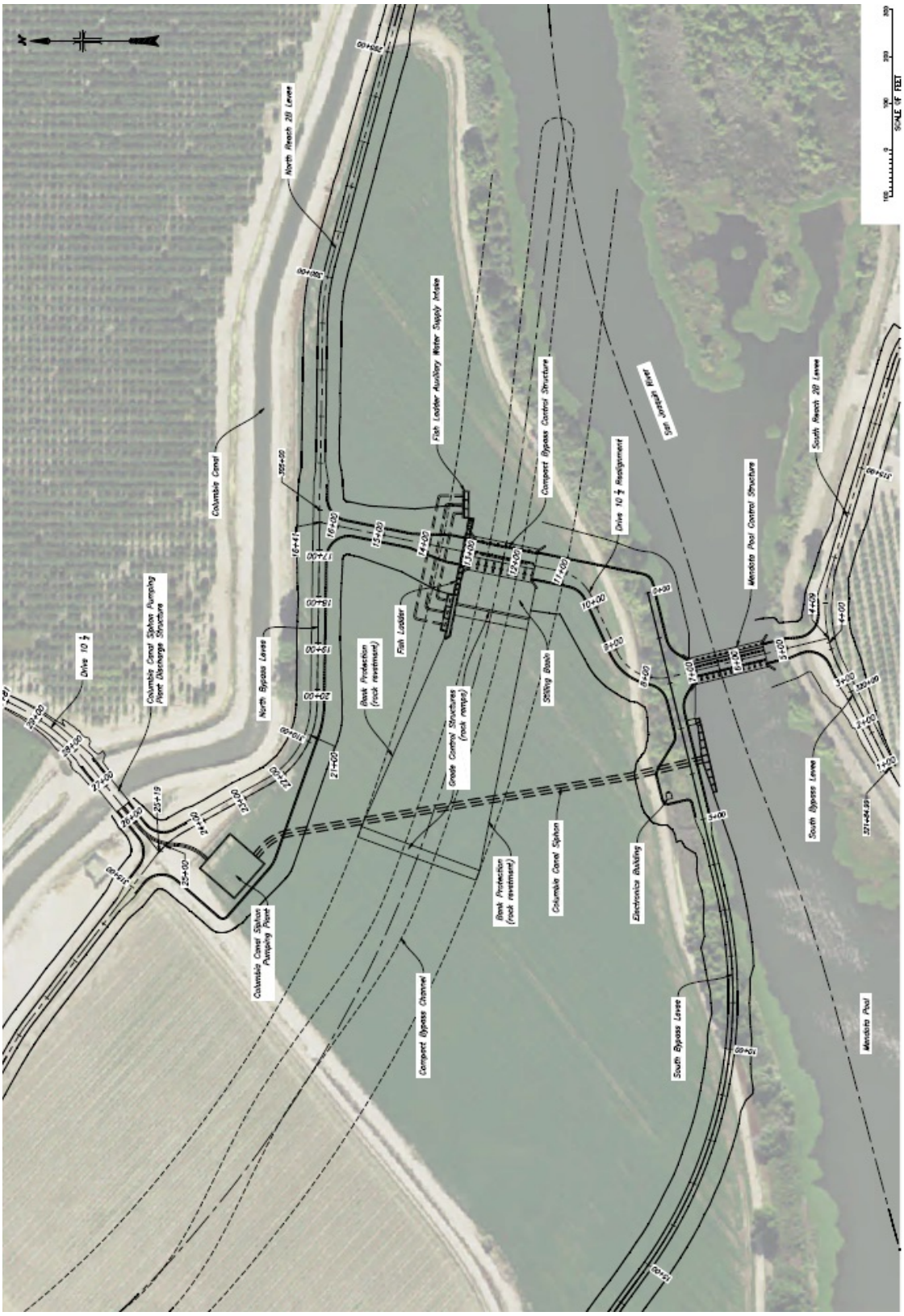


Figure 2-5.
Preliminary Site Plan for the Compact Bypass Structures

2.2.8 Mendota Pool Fish Screen

A fish screen would be included adjacent to the head of the Compact Bypass, at the Mendota Pool Control Structure, where water deliveries would be diverted from the river to Mendota Pool. The fish screen would keep or return out-migrating juvenile salmon to the Compact Bypass (the path of Restoration Flows) during water deliveries. The Compact Bypass structures are only operated for Exchange Contractor diversions in summer months in highly infrequent dry years or during flood flow deliveries, when flows split several times before entering Mendota Pool and fish survival through the bypasses is high.

The screen would be designed to pass flow up to 2,500 cfs. The type of fish screen could be a fixed flat plate in "V" configuration, vertical flat plate, inclined flat plate, cone, or cylindrical screens. Depending on the design type, the fish screen facility may include trash racks, stainless steel wedge wire fish screens, flow control baffle systems behind the screens, screen cleaning systems for the trash racks and screens, bypass flow control weirs, fish-friendly pumps, and/or fish bypass pressure pipelines. The trash racks would be installed at the entrance to the screen structures to protect screens from trash, logs, and other large debris.

Approach, sweeping, and bypass entrance velocities would be kept within established fish screen criteria (NMFS 2008). Flow through the fish screens may be controlled by baffles behind the fish screens. Cleaning of the screens would be accomplished using an automated brush system. Electric power would be needed for fish friendly pumps, if included, and screen cleaning systems. Operation of the fish screens would include methods to reduce predation of juvenile fish (e.g., noise systems to scatter predators, netting, and periodic draining of the screen return pipes).

2.2.9 Grade Control Structures

There would be two grade control structures, designed as rock ramps per the *Rock Ramp Design Guidelines* (Reclamation 2007) and *Hydraulic Design of Flood Control Channels, EM 1110-2-1601* (Corps 1994). The most upstream one would be located immediately downstream of the Compact Bypass Control Structure. The second grade control structure would be located near the Columbia Canal siphon crossing. The siphon crossing would be located approximately underneath the second grade control structure so that the grade control structure would also serve to protect the siphon crossing. Each grade control structure will have approximately 0.4 feet of drop across it. Each structure will have a maximum downstream slope of 0.04 and be a minimum of 25 feet in length in the streamwise direction (see Figure 2-6). Rocks would be approximately 12 inches in diameter. Two filter layers would be constructed underneath the rock ramps, one of gravel and one of sand. Rocks would be approximately 12 inches in diameter.

Rock ramps have benefits for native fish migration, but they present construction challenges in the sandy substrate of the Reach 2B and Reach 3 area. The flow over constructed rock riffles may reduce the disorienting effects on juveniles from rapidly changing hydraulics otherwise created at weir structures, and they are more favorable to sturgeon, which do not jump. Constructed rock riffles may be less favorable to predators which can hold in the quiescent pools below weir structures. However, placing rock in sandy substrate requires engineered foundation materials (layers of rock in gradually decreasing sizes) to prevent undermining the structure.

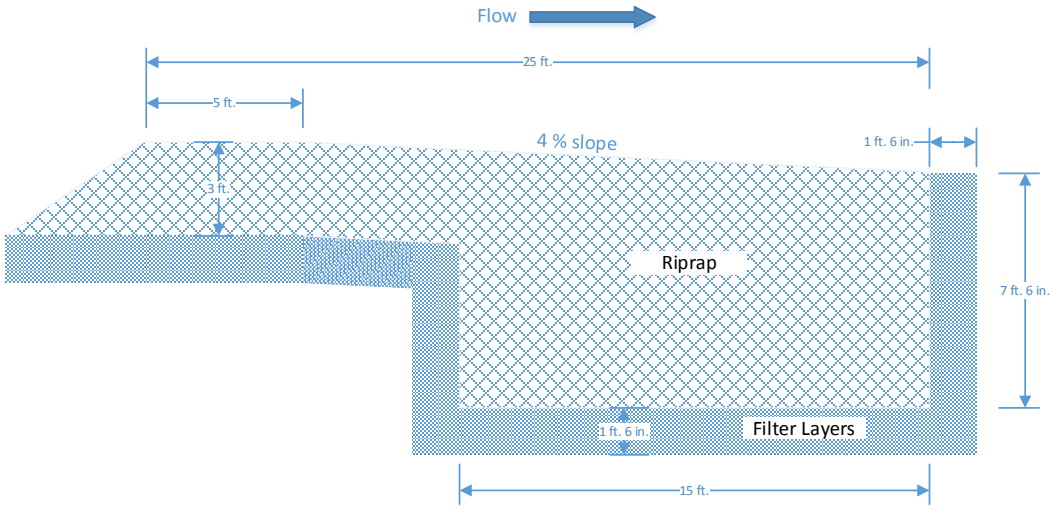


Figure 2-6.
Conceptual Profile View of Grade Control Rock Ramps

Each grade control structure would extend across the main channel and key into the overbanks to protect against flanking, resulting in a total structure width of about 270 feet.

2.3 Fish Passage Criteria

The Project includes provision of fish passage at structures for salmonids and other native fish. These structures include fish passage facilities, grade control structures, and bifurcation structures (under certain flows). The designs for structures with fish passage components would be based on criteria in *Anadromous Salmonid Passage Facility Design* (NMFS 2008) and *Guidelines for Salmonid Passage at Stream Crossings* (NMFS 2001). Specifically, the Project would provide suitable hydraulic conditions for passage of up-migrating adult salmonids, out-migrating juvenile salmonids, and some inter-reach migration of other native fish between Reach 2A and Reach 3. Suitable hydraulic conditions include those conditions which the species is physically capable of passing and do not cause undue stress on the animal. The passage features would be designed to cause no physical harm to fish. The design criteria are structured around the life stages of the target anadromous species and the timing of the runs for upstream movement of adult fall and spring run Chinook and winter steelhead and the downstream movement of juvenile life stages spawned from these runs. Recommended criteria are based on a combination of swimming ability of the fish species as reported in scientific papers and criteria in agency design guidelines. Recommended design criteria to provide for successful fish passage (depth of flow, suitable velocity ranges and jump height) are provided in Final EIS/R Table 2-1 Fish Passage Design Criteria The design criteria for a particular species would be met over the associated flow range (minimum flow to maximum flow). For sturgeon, lamprey, and other native fish, criteria would be met for some portion of the applicable fish migration period.

Table 2-1.
Fish Passage Design Criteria

Species	Life-stage	Migration Timeframe	Frequency	Minimum Flow	Maximum Flow	Maximum Velocity [1]	Minimum Water Depth [2]	Maximum Jump Height [3]	Minimum Pool Depth
			years	cfs	cfs	fps	feet	feet	feet
Chinook salmon	Adult	Spring and fall pulse	All years except CL	115 [4]	4,500	4.0	1.0	1.0	[5]
	Juvenile (downstream)	Nov-May	All years except CL	85 [6]	n/a	n/a	1.0	n/a	[5]
Steelhead	Adult	Spring and fall pulse	All years except CL	115 [4]	4,500	4.0	1.0	1.0	[5]
	Juvenile (downstream)	Nov-May	All years except CL	85 [6]	n/a	n/a	1.0	n/a	[5]
Sturgeon	Adult	Spring pulse	W and NW years	-	-	6.6	3.3	None – swim through	n/a
Lamprey	Adult	Spring pulse	All years except CL	-	-	[7]	[7]	[7]	n/a
Other native fish	Adult	Spring pulse	W, NW, and ND years	-	-	2.5 [8]	1.0 [8]	None – swim through	n/a

W = wet; NW = normal wet; ND = normal dry; CL = critical low

[1] Recommended maximum velocities shown are for grade control structures or structures with short longitudinal lengths based on *Anadromous Salmonid Passage Facility Design* (NMFS 2008) and *Guidelines for Salmonid Passage at Stream Crossings* (NMFS 2001). For structures with longer lengths (e.g., culverts and bifurcation structures under certain conditions), maximum velocities would be developed based on criteria in *Anadromous Salmonid Passage Facility Design* (NMFS 2008) and *Guidelines for Salmonid Passage at Stream Crossings* (NMFS 2001).

[2] Minimum water depth criteria based on 1.5 times body depth or 1 foot depth, whichever is greater based on *Anadromous Salmonid Passage Facility Design* (NMFS 2008) and *Guidelines for Salmonid Passage at Stream Crossings* (NMFS 2001).

[3] Maximum jump height criteria based on criteria in *Anadromous Salmonid Passage Facility Design* (NMFS 2008) and *Guidelines for Salmonid Passage at Stream Crossings* (NMFS 2001).

[4] Based on Exhibit B lowest flow in the fall spawning period (starts Oct 1) for the desired frequency; all Spring Pulse Flows are higher.

[5] Pool depths to be based on criteria in *Anadromous Salmonid Passage Facility Design* (NMFS 2008) and *Guidelines for Salmonid Passage at Stream Crossings* (NMFS 2001).

[6] Based on lowest flow within desired migration period for the desired frequency.

[7] Lamprey designs to be based on criteria in *Best Management Practices for Pacific Lamprey* (USFWS 2010)

[8] Based on hardhead and hitch.

The Project includes facilities that fish would encounter or need to pass to migrate between Reach 3 and Reach 2A (from downstream to upstream). A screen for the diversion to Mendota Pool would be included in the Project. The need for fish screens at other diversion facilities would be further evaluated as Project planning and design continues. The following fish screens are included in the Project in the event that they are determined necessary: the Lone Willow Slough fish screen (see Final EIS/R Section 2.2.4), Big and Little Bertha pumps screens, and screens on other

smaller diversions. Each structure represents a potential stressor for adult salmon and potential predation site for juvenile salmon. However, each structure would be designed to perform according to fish passage and screening design criteria. In addition, the channel and floodplain elements of the Project incorporate riparian areas to provide cover, woody material, and velocity variability, while the design footprint allows sufficient space to accommodate channel structure variability, all of which may help to reduce stress and predation.

During construction, impacts to fish would be minimized by including some or all of the following measures:

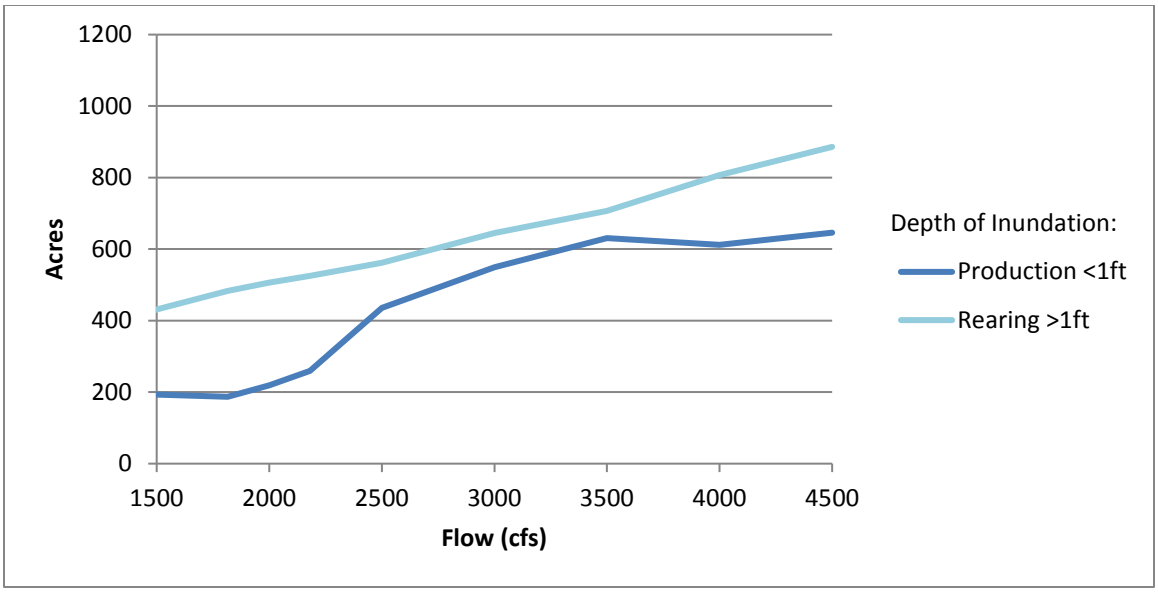
- Temporary bypass facilities around construction areas that meet fish passage criteria.
- Construction in the dry (i.e., not in active flows).
- Phased construction that would allow passage to continue in the channel or in the completed portions of structures while other portions are built.
- Fish rescue and relocation.

2.4 Fish Habitat and Passage

The purpose of the floodplain would be to provide riparian and floodplain habitat and support the migration and seasonal rearing of salmonids and other native fishes in Reach 2B. Floodplains would be developed in accordance with the Rearing Habitat Design Objectives. The floodplain has an average width of approximately 4,200 feet and an inundated area of approximately 1,000 acres at 2,500 cfs.

The Project provides floodplain habitat resulting in approximately 440 acres of shallow water habitat for primary production as well as approximately 560 acres of habitat that supports direct rearing at 2,500 cfs. Approximately 44 percent of the floodplain would inundate less than 1 foot deep at 2,500 cfs. The Project also retains approximately 650 acres of shallow water habitat at flows of 4,500 cfs. Figure 2-7 below presents conceptual inundation areas for primary production and rearing habitats as they vary by flow. Inundation acreages may change during the design process.

In the Compact Bypass channel, floodplain benches with an approximate average width of 100 feet on each side of the low flow portion of the bypass channel are included (see section “Compact Bypass Channel”). Riparian and floodplain habitat would be planted and developed on the benches in the bypass channel to benefit migrating fish and promote a stable channel and sediment transport from Reach 2B to Reach 3.



Source: Reclamation 2015

Figure 2-7.
Potential Inundation Acreage by Flow

The Project includes several facilities that fish may encounter or need to pass to migrate between Reach 3 and Reach 2B (from downstream to upstream):

- Two in-channel grade control structure rock ramps in the Compact Bypass.
- Four fish screen return outlets from the Mendota Pool fish screen.
- A bifurcation control structure at the upstream end of the Compact Bypass with fish passage facility.
- The Mendota Pool fish screen adjacent to the upstream end of the Compact Bypass.
- Fish screens at Lone Willow Slough, Big and Little Bertha pumps, and other smaller diversions, if determined necessary (these screens are discussed in Final EIS/R Section 2.2.4).
- The San Joaquin River control structure at the Chowchilla Bifurcation Structure with a fish passage facility.

Each structure would be designed to perform according to the fish passage design criteria. In addition, the channel and floodplain incorporate riparian plantings to provide cover, woody material, and velocity variability, while the design footprint allows sufficient space to incorporate channel structure variability during detailed design, all of which may help to reduce stress and predation.

The Project does not include a fish barrier at the downstream end of the Compact Bypass to keep fish from migrating upstream of the Compact Bypass in Reach 3 toward the base of Mendota Dam.

2.5 Floodplain and Riparian Habitat

The Project includes a mixture of active and passive riparian and floodplain habitat restoration and compatible agricultural activities in the floodplain. Active restoration planting of native riparian species would occur along both banks of the low flow channel of the river up to 450 feet from the bank, and would be irrigated with a planting density of approximately 545 plants per acre. In accordance with the Rearing Habitat Design Objectives, it would include native species that would provide shade and reduce air temperatures to help minimize water temperatures, provide large woody debris and organic matter needed to provide habitat and food, and help stabilize the low-flow channel. The irrigated area would include 16-foot spacing between irrigation lines for equipment access and 5-foot spacing along irrigation lines to maximize density. Forbs and grasses would be planted as plugs or transplants in between irrigation lines in order to encourage structural diversity. Some areas may be passively revegetated by creating riparian establishment areas that provide a riparian seed bank of native species. The remaining areas would be seeded with native grasses and forbs to minimize erosion and to help control invasive species. These upland areas will be broadcast seeded or drilled with incorporation as necessary.

Active revegetation activities would likely include a combination of seeding, transplanting, and pole/live stake plantings. Plantings may be designed as either clusters of trees and shrubs with larger areas of seeded grasses and forbs or as dense forests. Spacing and alignment of plantings would take into account species growth patterns, potential equipment access needs for monitoring and maintenance, and desired future stand development. Passive restoration would occur in areas that rely on Restoration Flows for additional vegetation recruitment. Natural riparian recruitment (passive restoration) would promote continual habitat succession, particularly in areas where sediment is deposited or vegetation is removed by natural processes. Table 2-2 lists the species that are likely to be planted or seeded during active restoration, and is draft and subject to change.

Emergent wetlands and water tolerant woody species of riparian scrub would be selected for development within the main channel, woody shrubs and trees with an herbaceous understory would be selected for development along the main river channel banks, and bands of other habitat types (e.g., grasses) would be selected for development at higher elevations along the channel corridor. Active vegetation restoration would occur following construction and these areas would be irrigated and managed as necessary during the establishment period. Phased implementation of active vegetation restoration at strategic locations could occur concurrently with phased implementation of construction and physical infrastructure.

Agricultural practices (e.g., annual crops, pasture, or floodplain-compatible permanent crops) could occur on the floodplain in previous agricultural areas outside of existing wetlands and State-owned and public trust lands and within future upland areas. Growers would be required to leave cover on the ground and would be required to develop and implement a Water Quality Plan, approved by Reclamation, to meet current water quality standards for aquatic resources and cold-water fisheries, as well as meeting the specific needs for anadromous fishes in adjacent and

downstream areas. If grazing occurs the lessee would be required to develop and implement a Grazing Plan, approved by Reclamation in coordination with CSLC, in addition to the Water Quality Plan.

Table 2-2.
Potential Species for Revegetation

Common Name	Scientific Name	Vegetation Type
Riparian Shrub and Wetland Areas (0 to 2 feet above summer baseflow elevations)		
Fremont cottonwood	*Populus fremontii*	Tree
Gooding's willow	*Salix gooddingii*	Tree
box elder	*Acer negundo*	Tree
Oregon ash	*Fraxinus latifolia*	Tree
red willow	*Salix laevigata*	Tree
yerba mansa	*Anemopsis californica*	Forb
common buttonbrush	*Cephalanthus occidentalis*	Shrub
Baltic rush	*Juncus balticus*	Tule
California blackberry	*Rubus ursinus*	Shrub
sandbar willow	*Salix exigua*	Shrub
arroyo willow	*Salix lasiolepis*	Shrub
shining willow	*Salix lucida* ssp. *Lasiandra*	Tree
blue elderberry	*Sambucus nigra* ssp. *caerulea*	Shrub
meadow barley	*Hordeum brachyantherum*	Grass
Creeping wildrye	*Elymus triticoides*	Grass
dwarf barley	*Hordeum depressum*	Grass
Douglas' sagewort	*Artemisia douglasiana*	Forb
Great Valley gumweed	*Grindelia camporum*	Forb
Western goldenrod	*Euthamia occidentalis*	Forb
meadow barley	*Hordeum brachyantherum*	Grass
Creeping wildrye	*Elymus triticoides*	Grass
dwarf barley	*Hordeum depressum*	Grass
Dense Riparian Areas (2 to 8 feet above summer baseflow elevations)		
meadow barley	*Hordeum brachyantherum*	Grass
Creeping wildrye	*Elymus triticoides*	Grass
dwarf barley	*Hordeum depressum*	Grass
Douglas' sagewort	*Artemisia douglasiana*	Forb
Great Valley gumweed	*Grindelia camporum*	Forb
Western goldenrod	*Euthamia occidentalis*	Forb
meadow barley	*Hordeum brachyantherum*	Grass
creeping wildrye	*Elymus triticoides*	Grass
red willow	*Salix laevigata*	Tree
shining willow	*Salix lasiandra* var. *lasiandra*	Tree
arroyo willow	*Salix lasiolepis*	Shrub
box elder	*Acer negundo*	Tree
narrow-leafed milkweed	*Asclepias fascicularis*	Herb
coyote brush	*Baccharis pilularis*	Shrub
buttonbush	*Cephalanthus occidentalis*	Shrub
blue wildrye	*Elymus glaucus*	Grass
valley oak	*Quercus lobata*	Tree

Common Name	Scientific Name	Vegetation Type
golden currant	*Ribes aureum*	Shrub
California wildrose	*Rosa californica*	Shrub
California blackberry	*Rubus ursinus*	Shrub
Gooding's willow	*Salix gooddingii*	Tree
blue elderberry	*Sambucus nigra* ssp. *caerulea*	Shrub
Upland Areas (greater than 8 feet above summer baseflow elevations)		
creeping wildrye	*Elymus triticoides*	Grass
California wildrose	*Rosa californica*	shrub
narrow-leafed milkweed	*Asclepias fascicularis*	Forb
valley oak	*Quercus lobata*	Tree
golden currant	*Ribes aureum*	shrub
quail bush	*Atriplex lentiformis*	Forb
western goldenrod	*Euthamia occidentalis*	Forb
small fescue	*Festuca microstachys*	Grass
purple needlegrass	*Stipa pulchra*	Grass
yarrow	*Achillea millefolium*	Forb
Spanish lotus	*Acmispon americanus* var. *americanus*	Forb
Great Valley gumweed	*Grindelia camporum*	Forb
telegraph weed	*Heterotheca grandiflora*	Forb
tomcat clover	*Trifolium willdenovii*	Forb

2.5.1 Existing Native Vegetation Protection

The existing native vegetation in the Project area designated to remain would be temporarily fenced with orange snow fencing (or equivalent) to prevent entry, driving, parking, or storing equipment or material within these areas during construction. Existing vegetation would be left in place or only minimally trimmed to facilitate access and work at the site. The existing soil is suitable for growing all of the desired native plants. In order to maximize plant growth and planting success, existing soil and topsoil would be preserved, and in areas where excavation is required, would be stockpiled to later place on top of the excavated bypass channel for planting. If the soil contains invasive non-native seed or fragmented stems and rhizomes, it would not be preserved.

2.5.2 Invasive Species Control

Invasive, non-native species would be removed from the Project area during the installation, plant establishment and maintenance periods. Invasive species management would consist of removal of the most invasive non-native species within the reach such as giant reed grass (*Arundo donax*), perennial pepperweed (*Lepidium latifolium*) and poison hemlock (*Conium maculatum*). Invasive species management would also include removal of other invasive species that are currently found in upstream reaches and may eventually colonize in the Project area such as red sesbania (*Sesbania punicea*), salt cedar (*Tamarix species*), and Chinese tallow (*Sapium sebiferum*). Invasive plant removal techniques may include mechanical removal, root excavation, hand pulling, mowing, disking, controlled burning, grazing, aquatic-safe herbicides, or a combination of techniques as appropriate.

The SJRRP has an existing invasive species management plan, and completed the *Invasive Vegetation Monitoring and Management Environmental Assessment* in 2012 that describes the methods that would be followed for Reach 2B invasive species removal. Details are provided in Section 2.2 of the Environmental Assessment (SJRRP 2012).

2.5.3 Temporary Irrigation System and Water Supply

Proposed plantings that are wetland species or borderline wetland species would need regular aboveground irrigation (typically April through October) during their establishment period (typically 3 to 5 years depending on rainfall conditions and the plants' growth rates and vigor). The amount of water needed is estimated to be approximately 2.4 acre feet per year. An extensive temporary aboveground irrigation system, such as aerial spray, would provide water for the plants several times a week during the hot months of the year. If an aerial spray irrigation system is installed, the irrigation distribution piping would be installed aboveground and anchored to the ground so that it would not be damaged during high flows inundating the floodplain. If an aerial spray system is used, sprinkler heads would likely be installed on braced standpipes so that their irrigation stream would not be blocked or diverted by growing vegetation. The irrigation system would be disassembled and removed at the end of the establishment period.

The Program would pursue options for irrigation water supply, including groundwater wells or water pumped from the river with portable, skid-mounted, diesel- or gas-powered pumps and stored in tanks. Additionally, purchases from willing sellers may be required to withdraw water from the river or other nearby water sources (e.g., Mendota Pool). If water is pumped from the river, the amount of water diverted will be controlled so that river water temperatures do not increase and passage for salmonids is not impaired. The diversion from the river would also be screened if necessary to prevent entraining juvenile salmonids.

2.5.4 Maintenance and Monitoring

Maintenance and monitoring would be conducted following revegetation for 10 years, yearly for the first 3 years, every other year until year 7, and a final assessment at year 10. Monitoring activities include monitoring of the installed plants for drought stress and overwatering, identification of competitive, invasive, non-native species for removal, identification of diseased, dead and washed-out plants, irrigation system function, and identification of trash and debris for removal. Maintenance activities would include controlling invasive plant species, mitigating animal damage, irrigation, replacement of diseased, dead, or washed-out plants, irrigation system maintenance, and removal of trash and debris. Management of invasive species would ensure that the desirable vegetation dominates the landscape and provides habitat diversity, productivity, and sustainability. Animal damage to newly planted or germinated vegetation could be alleviated with screens, aquatic-safe chemical deterrents, or other exclusion methods.

Temporary irrigation of wetland and riparian areas during establishment, especially if precipitation is below normal, would facilitate root system development into the alluvium groundwater. Irrigation infrastructure would need to be installed and remain in place for at least 3 years. The irrigation system would be used each year on a biweekly to daily basis during the hot part of the growing season. The landscape contractor would be required to regularly check the integrity of the system and make sure that system is not clogged or damaged. Upland areas would be seeded in the fall before the winter precipitation season, and it is likely that these areas

would become established to an acceptable level after one season of normal precipitation. (There may be more than one active revegetation effort required to establish a dense riparian corridor necessary to naturally stabilize the Compact Bypass channel.) Removal of trash and debris from the restoration areas on both sides of the river would be performed on an as-needed basis for the duration of the entire monitoring period. Monitoring is anticipated in years 1, 2, 3, 5, 7, and 10 after planting. After 10 years of monitoring and replacement as necessary, vegetation would be established.

2.5.5 Long-Term Management

While it is not anticipated that major management actions would be needed, the key objective of management would be to monitor and identify any environmental issues that arise, and use adaptive management to determine what actions would be most appropriate to correct these issues.

The general management approach to the long-term maintenance of the floodplain areas would be to maintain quality habitat for each natural resource, with on-going monitoring and maintenance of key environmental characteristics of the entire floodplain area within the reach. An adaptive management approach would be used to incorporate changes to management practices, including corrective actions as determined to be appropriate by Reclamation. Adaptive management includes those activities necessary to address the effects of climate change, fire, flood, or other natural events, force majeure, etc.

The expected long-term management needs (and activities necessary to maintain any on-site mitigation sites) would be:

- Resource specific long-term maintenance activities and other general maintenance activities such as exotic species elimination, grazing management, clean-up and trash removal,
- Infrastructure management such as gate, fence, road, culvert, signage and drainage-feature repair, and
- Other maintenance activities necessary to maintain the riparian and floodplain habitat quality.

These activities are expected to continue for the life of the Project.

2.6 Water Deliveries

The Project includes a diversion at the head of the Compact Bypass – the Mendota Pool Control Structure – for making up to 2,500 cfs in water deliveries from the San Joaquin River to Mendota Pool. This diversion would directly deliver water from the river to Mendota Pool without the need for a canal. Water deliveries to the Pool would include diversion of Friant Dam releases that are meant to satisfy the Exchange Contract as well as diversion of San Joaquin River flood flows up to 2,500 cfs if there is demand in Mendota Pool.

When water deliveries occur, the gates at the Compact Bypass structures would be manipulated to control flows into the Compact Bypass and allow flows into Mendota Pool. Since the Mendota Pool operating elevation is several feet higher than the bottom of the Compact Bypass channel, operation of the gates would include backwatering a portion of the San Joaquin River

upstream of the Compact Bypass structures. The extent of the backwater is anticipated to be similar to the extent of the Mendota Pool backwater under existing conditions (i.e., upstream to approximately the existing San Mateo Avenue crossing). Up-migrating fish passage from the Compact Bypass into Reach 2B would occur through the Compact Bypass fish passage facility during water deliveries. The Mendota Pool fish screen would capture out-migrating fish entering the diversion and return them to the Compact Bypass. Sufficient flow to support adult and juvenile fish passage through the Compact Bypass fish passage facility would be maintained during water delivery operations during fish migration periods.

In 2014 and 2015, releases from Friant Dam were required to meet the conditions of the Exchange Contract for the first time. These releases were unprecedented in the record, and occurred in critical-high and critical-low water year types, respectively. In the future, Friant Dam releases to satisfy the Exchange Contract could occur at any time and in any water year type; however, it is anticipated that these releases would most likely occur during critical-high and critical-low water years and typically in the late spring and summer (May to September) when irrigation demand is high.

Flood flows released from Friant Dam can be broken down into two types: a) precautionary releases to increase reservoir capacity in order to attenuate expected runoff, and b) mandatory releases due to reservoir at or near capacity. Flood flows tend to be bimodal, with early season flood flows in February and March, consisting mostly of precautionary releases, and late season mandatory flood flows in June through August. Precautionary flood releases occur in the record every 3 ½ years on average, and with very few exceptions occur during February and March. These have occurred during all water year types except critical–low. Mandatory flood releases occur every 4 years on average, though not always on the same year that precautionary flood releases do. These typically occur during June and July, yet occasionally span from May through August in extremely wet years. All mandatory flood releases occur during wet and normal–wet year types.

Based on the hydrologic record, water deliveries would occur in approximately 36 of 82 years, with the majority (approximately 31 of the 82 years) being flood deliveries.

2.7 Levees

Setback levees would be required along the Project area to contain Restoration Flows. While the height and footprint of the levees vary according to their location along the channel and the ground elevation, the capacity, freeboard, and cross-section would be consistent. Localized backwater and redirection effects at Project structures would be considered during design of levee heights. Levees would be designed to maintain at least 3 feet of freeboard on the levees at 4,500 cfs. Levee design would be based on the U.S. Army Corps of Engineers (Corps) *Engineer Manual 1110-2-1913-Design and Construction of Levees* guidelines (Corps 2000a) and *Engineer Technical Letter 1110-2-583 Guidelines for Landscape Planting and Vegetation Management at Levees, Floodwalls, Embankment Dams and Appurtenant Structures* (Corps 2014). The design includes seepage control measures, maintenance roads, and inspection and drainage trenches to direct off-site drainage where required.

Levee alignments maintain a 300-foot buffer zone, where appropriate, between the levee and river channel to avoid impact to levees over time due to potential channel migration. In areas where a minimum 300-foot buffer zone between the main river channel and levee cannot be maintained, bank revetment would be incorporated in the design.

New levees would be designed to have sideslopes of 3 horizontal to 1 vertical (3H:1V) on the waterside and landside. A maintenance road and surface drainage ditch would also be included. Surface drainage ditches would only be intended to capture and direct runoff; they are not intended to address groundwater seepage or through-levee seepage. By following the Corps standards, all levees would have an inspection trench or would include a cut-off wall. Additional data collection and analysis would be required to verify the groundwater conductivity rates of the *in situ* and borrow soils and to finalize the design of seepage control measures.

The levee alignments shown on the plan views of the Project may be adjusted during final design. Adjustments may be made for several reasons, including to improve flow conditions on the floodplain, to improve habitat conditions on the floodplain, to reduce potential erosion, to accommodate adverse soil conditions, and to avoid existing infrastructure among others. The final levee alignments will be within the impact areas evaluated in this document.

2.8 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 necessary, in the Project in areas where under-seepage is likely to affect adjacent land uses. Seepage control measures could include: cut-off walls, interceptor drains or ditches, seepage wells, seepage berms, seepage easements and other measures that can be implemented within the Project area.[1]

2.9 Borrow

Borrow material would primarily be required for the construction of the levees, but it may also be used in the construction of other structures for foundation or backfill material. Levees may be constructed entirely of local borrow material, a mix of local and imported borrow material, or just imported borrow material. Geotechnical investigations to date indicate that local borrow

[1] A cut-off wall is a construction technique to reinforce areas of soft earth that are near open water or a high groundwater table with a mixture of soil, bentonite, and cement. Interceptor drains are buried perforated pipes and interceptor ditches are surface ditches, both of which intercept groundwater and redirect it to a discharge point. Because the drains and ditches have lower resistance to flow, the groundwater table can be kept artificially low in areas near the pipe or ditch. The discharge point could include a lift pump to move drained water over the levees, or it could be discharged directly to a surface water body (e.g., agricultural canal). Seepage wells are groundwater wells that are used to pump and draw down the water table where seepage is occurring. Seepage berms are berms placed on the landside of a levee to add additional weight and width to the levee to counteract seepage.

may be sufficient, so it is assumed that all levee fill will come from local borrow sites. Topsoil from local borrow areas would be stockpiled for reuse at the borrow site or within the Project area.

The locations of borrow areas are dependent on the locations of suitable materials. To the extent that suitable materials and the locations for floodplain grading coincide, borrow from those areas is preferred. Borrow from within the Project levees will be designed to be compatible with native fish habitat and uses by either reconnecting to the river channel or by restoring to an appropriate elevation to prevent stranding.

It is estimated that up to 350 acres of land total will be needed for borrow areas. This includes borrow locations inside and outside the Project. Borrow areas will avoid sensitive biological resources to the extent practicable. Borrow areas will also avoid permanent crops outside of the Project levees.

2.10 Levee and Structure Protection

The Project generally provides a minimum 300-foot buffer between the existing channel and the proposed levee, where appropriate and feasible. For locations where the 300-foot buffer was not included, erosion protection for the levee in the form of revetment would be included. The revetment would be riprap material covered by soil and then planted to provide a vegetated surface. However, softer approaches, such as bioengineering or dense planting, may be considered during design depending on velocities and scour potential. Locations that require revetment include areas where the 300-foot buffer was not included due to the proximity of existing infrastructure, near the proposed structures, and along river bends less than 300 feet from the levee in areas that have the potential to erode, as determined in the design process.

2.11 Channel Bank Protection

The Project could include riparian vegetation, rock vanes, woody materials, revetment, or other measures designed to protect channel banks from erosion. Bank protection measures would be installed in locations susceptible to and likely to experience bank erosion.

Bank protection measures would be incorporated into the bypass between the Compact Bypass Control Structure and the downstream most grade control structure, totaling about 500 linear feet of bank protection on either side of the Compact Bypass channel. Downstream of the grade control structure, no bank protection would be necessary after establishment of riparian vegetation. Bank protection measures could include: vegetated revetment, rock vanes, bioengineering techniques, and riparian vegetation. It is assumed that the vegetated revetment would consist of buried riprap of approximately 12 inches in diameter, covered with topsoil, erosion control fabric, and native woody vegetation, so that fish would experience natural channel banks. Rock vanes would be constructed to only interact with the flow if erosion occurs (i.e., the top of the vane will be level with the constructed overbank surface). Bioengineering techniques could include vegetated geogrids, fabric encapsulated soil banks, brush mattresses, and root wads. Native woody vegetation directly upstream, downstream, and adjacent to the grade control structures would provide shading and opportunities for juveniles to hide from

predators. Bank protection measures would also be incorporated into channel banks at locations upstream of the Compact Bypass.

2.12 Removal of Existing Levees

Removal of portions of the existing levees is included and designed to expand the inundation area of the floodplain out to the proposed levees and improve connectivity between the river channel and proposed floodplain. The locations of existing levee removal would be based upon the hydraulic performance of the channel and floodplain. In certain locations, however, highly desirable existing vegetation (native and sensitive vegetation communities that can serve as seed banks for future vegetation communities) can be found on the existing levees. Where hydraulic performance and connectivity of the floodplain would not be negatively affected, portions of the existing levees with highly desirable vegetation would remain in place. Materials that are removed from the existing levees would likely be reused within the Project area.

2.13 Floodplain and Channel Grading

Floodplain and channel grading would be included with the Project. Floodplain and channel grading would include any or all of the following at locations to be determined during design:

- Creating high-flow channels through the floodplain to increase the inundation extent at lower flows.
- Connecting low-lying areas on the floodplain to the river to prevent stranding.
- Removing high areas where flow connectivity would be impeded (e.g., farm road grades).
- Excavating floodplain benches adjacent to the river channel to increase the frequency of inundation.
- Creating greater inundation depth diversity on the floodplain.
- Excavating channels in portions of the Project area to tie into existing elevations upstream and downstream of the Project or to create desirable sediment transport conditions.

Floodplain and channel grading can provide benefits to salmon and other native fish by allowing inundation to occur at lower flows, by distributing suitable rearing habitats further into the floodplain, by connecting rearing habitat to primary production areas (shallow water habitat), by providing escape routes during receding flows, and by confining flows to a deeper, narrower channel to limit temperature increases.

Figure 2-8 and Figure 2-9 provide an example of how various floodplain grading approaches can be used to expand inundation on the floodplain. The Existing Channel graphic shows an example of how inundation would occur without floodplain grading. The Lowered Floodplain example shows an example of how floodplain benches, lowered areas to either side of the channel, could be used to inundate floodplain areas at lesser flows. This graphic also shows how lowered floodplains could affect inundation at moderate flows. The High Flow Channels graphic shows an example of how high flow channels, side channels that initiate at larger flows than the main channel, could be used to expand floodplain inundation.

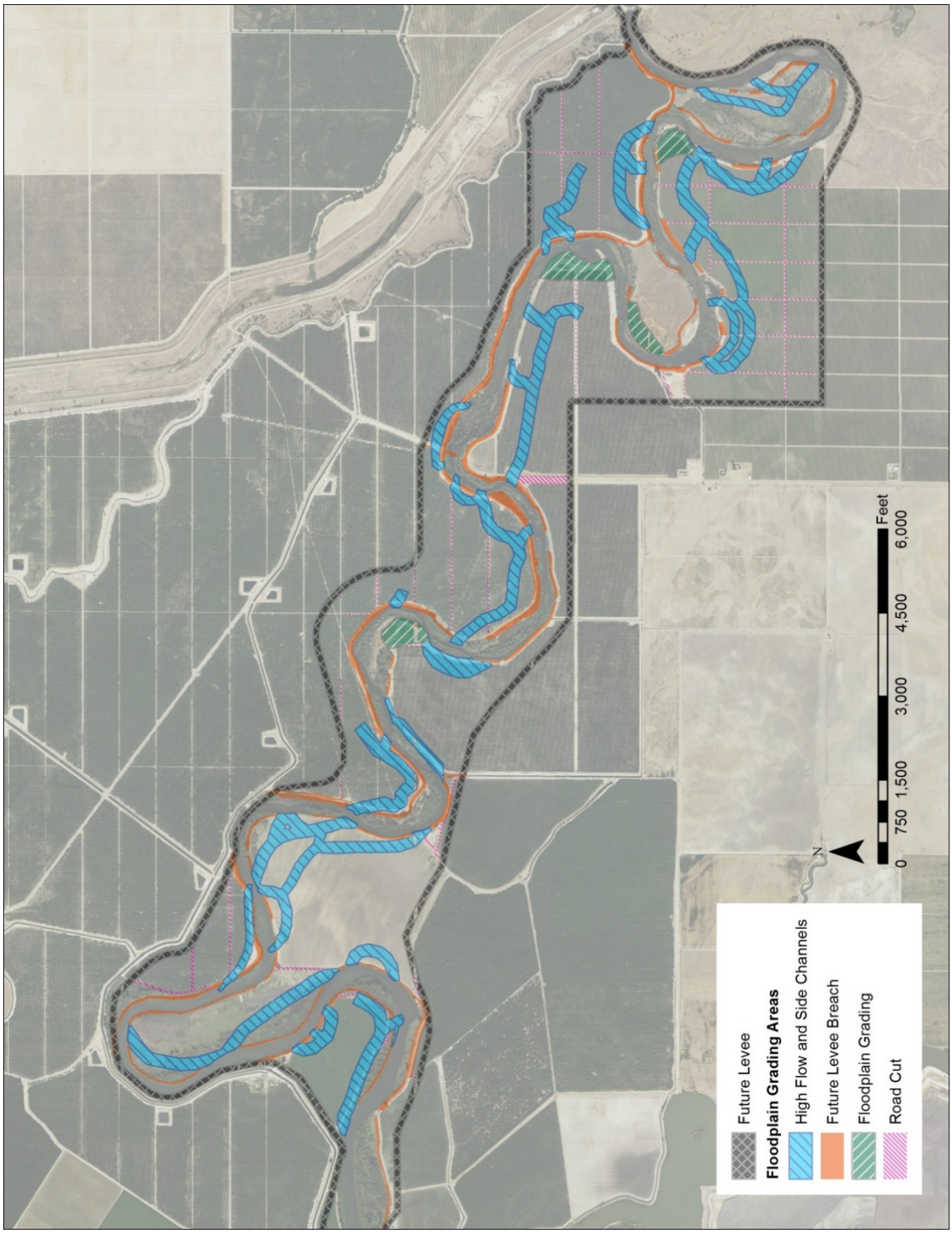


Figure 2-8.
Example Floodplain Grading Approach – Plan View

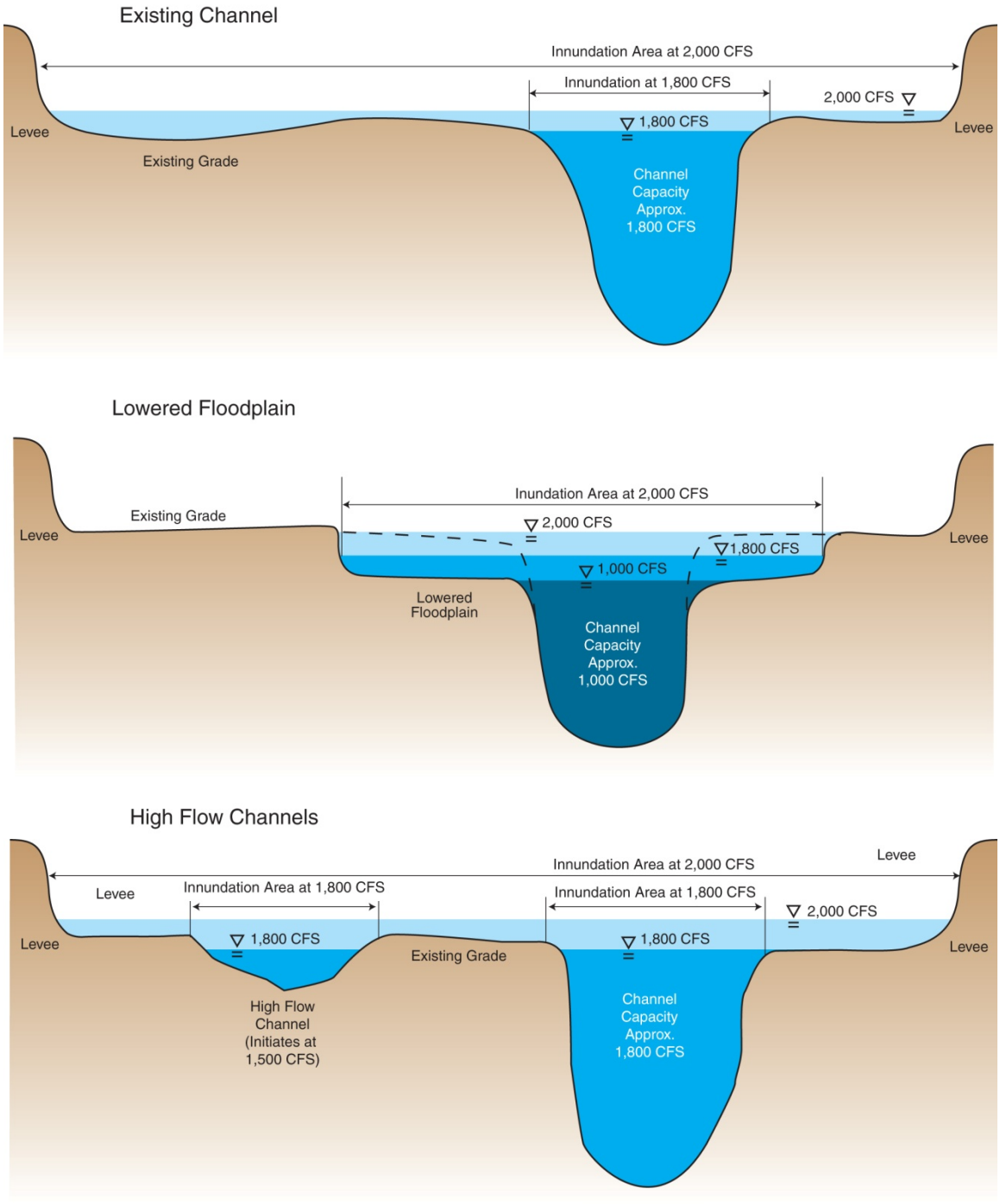


Figure 2-9.
Example Floodplain Grading Approaches – Cross Section

2.14 Lone Willow Slough Fish and Riparian Diversions Screens

Lone Willow Slough connects to the river at approximately River Mile (RM) 215.9 just downstream of the Chowchilla Bifurcation Structure. The Project would include construction of a fish screen at this diversion, if determined necessary. During flood control releases from Friant Dam and when the Exchange Contractors are exercising their water rights on the San Joaquin River in lieu of taking substitute water from the Delta-Mendota Canal, or when the adjacent landowner exercises their riparian rights, up to 125 cfs of water may be diverted for irrigation from Reach 2B into the Lone Willow Slough. A screen, if determined necessary, would prevent fish from entering the canal when flows are being diverted. The fish screen structure would consist of a 15-foot by 21-foot concrete hollow box, with the river side of the box open to river flows and the back of the box fitted with a board guide to control diversion into the irrigation canal. The opening at the riverside would include an automated cleaner system, trash rack and a fish screen to prevent migrating fish from entering the intake. The screen would be designed to meet *Anadromous Salmonid Passage Facility Design* (NMFS 2008) criteria.

There are existing diversion pumps located along Reach 2B (e.g., Big and Little Bertha pumps). These pumps would be retrofitted with fish screens, where required, to prevent migrating fish from entering the intakes. The screens would be designed to meet *Anadromous Salmonid Passage Facility Design* (NMFS 2008) criteria.

2.15 Geotechnical Investigations

Geotechnical investigations are required to evaluate soil suitability for final design of the Project, and may be required to conduct monitoring of seepage after construction of the Project. Geotechnical investigations may include hydraulic conductivity tests, soil sampling, soil salinity testing, installation of monitoring wells, back-hoe pits, Standard Penetration Tests, Cone Penetrometer Tests, or other forms of geotechnical investigations. All of these investigations are included as part of this Project, may occur anywhere within the Project area, are not limited in time, and do not require subsequent environmental analysis.

2.16 Surveys

Biological, cultural resources, and elevation surveys are required to complete final design of the Project and conduct post-project monitoring. Surveys may include trapping of species, monitoring of vegetation on transects or plots, visual, habitat assessment, reconnaissance, and protocol level endangered species act surveys, vegetation mapping, bathymetry surveys, elevation surveys, digging of cultural resource inspection trenches, water quality sampling, or any other surveys required for environmental compliance, permitting, design data collection, or monitoring activities. All of these investigations are included as part of this Project, may occur anywhere within the Project area, are not limited in time, and do not require subsequent environmental analysis. Species-specific surveys will be conducted by qualified biologists.

2.17 Infrastructure for Fish Monitoring

The designs for control structures, fish passage facilities, and fish screens include security fences and gates, mounting hardware, and electrical supply in order to conduct fish monitoring activities. Fish monitoring activities are expected to include connections for PIT (passive integrated transponder) tag arrays at the Compact Bypass Control Structure and San Joaquin River control structure of the Chowchilla Bifurcation Structure and Didson camera mounts at the edges of the Compact Bypass Control Structure and San Joaquin River control structure, as well as a vault and connection for a visual fish imaging technology in the Compact Bypass fish ladder. Acoustic tagging receivers can be placed at various locations within the reach and anchor points will be provided at structures, where appropriate. Construction, operations, and maintenance of the fish monitoring infrastructure are included as part of this Project. The fish monitoring activities themselves are not included in this Project, and will be addressed in subsequent environmental analysis, as appropriate.

2.18 Existing Infrastructure Relocations or Floodproofing

Some existing infrastructure (see Figure 2-10) such as groundwater wells, pumps, electrical and gas distribution lines, water pipelines, and canals located in the Project area would require relocation, retrofitting, or floodproofing to protect the structures from future Restoration Flows and increased floodplain area. Although the relocations, retrofits, and floodproofing are included as part of the Project, the actual relocation, retrofit, or floodproofing work may be performed by others. As a result of the Project, some existing infrastructure may be unnecessary in the future (e.g., power lines that service pumps relocated to outside the Project area). In these cases, infrastructure may be demolished or abandoned in place.

Specific plans for relocations, where known, are identified below:

- Natural gas pipelines will be buried lower in the soil column to avoid interference with project activities.
- Water pipelines will be either buried lower in the soil column or relocated outside of levees but within the Project area.
- City of Mendota's three groundwater wells located on the south side of the San Joaquin River to the east of Fresno Slough will remain in place. Two of them are outside of the levee alignments and will remain unaffected. The third well is immediately adjacent to the San Joaquin River and will be floodproofed, with the adjacent levee extending to protect the well.
- A new bridge may be constructed immediately adjacent to the Mowry Bridge, which holds the city of Mendota's water pipeline, for construction access.

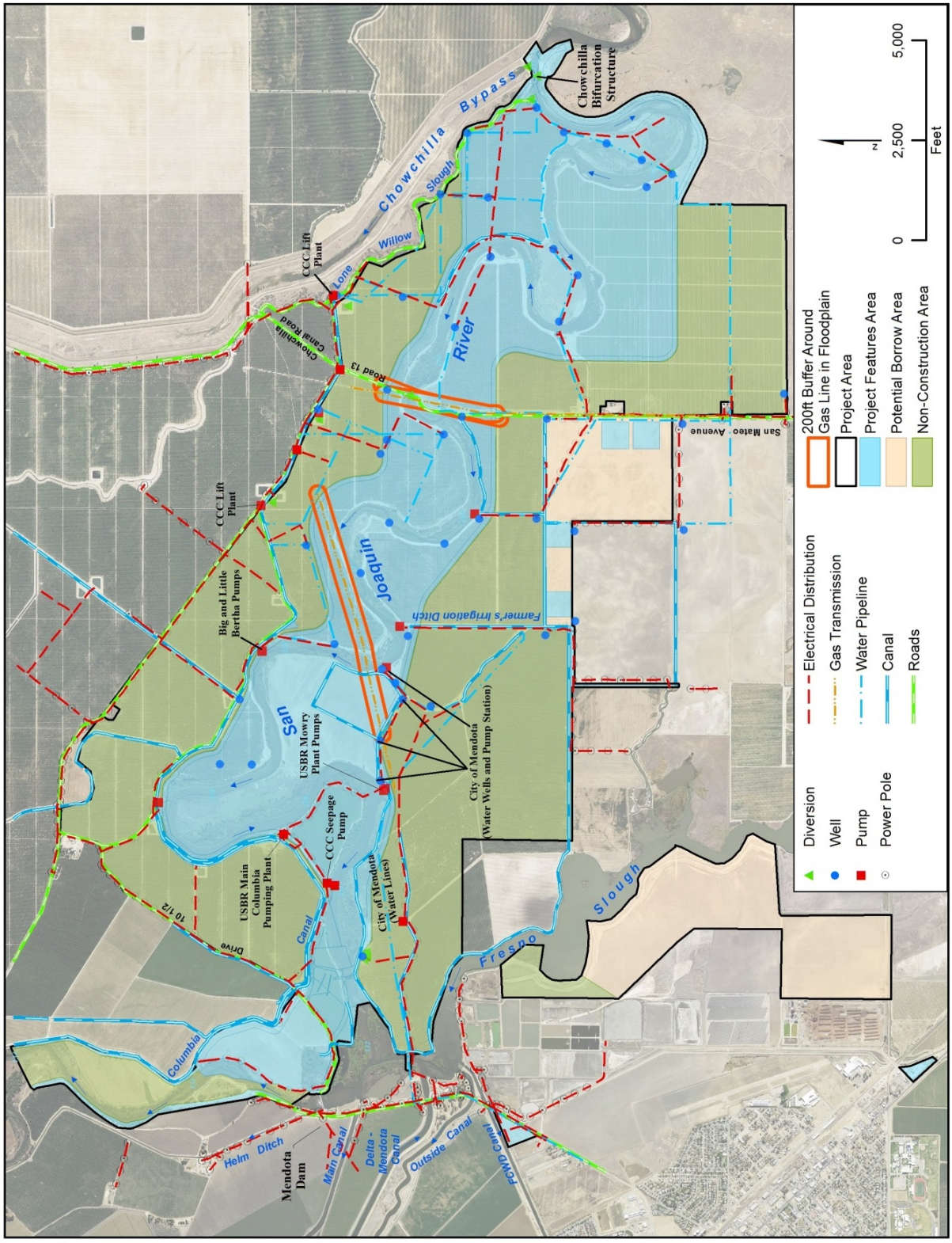


Figure 2-10.
Existing Infrastructure in the Project Area

2.18.1 Electrical and Gas Distribution

Approximately 68,000 feet of electrical distribution lines and 11,500 feet of gas distribution lines were identified for possible relocation in the Project area. Information from Pacific Gas & Electric (PG&E) was available for portions of the area in GIS shapefile format and was supplemented by field data. At the current level of design, it was assumed that a portion of the electrical and gas distribution lines found within the Project area would need to be replaced and/or excavated and buried lower in the soil column. Three gas pipelines are buried under the San Joaquin River in this reach. They will need to be re-buried deeper or floodproofed. This may involve trenching and excavation along the pipeline length, within and outside of the future floodplain area, to re-bury it deeper in the soil column below any potential impacts from floodplain grading within the Project area.

2.18.2 Canals and Drains

Approximately 56,000 feet of canals were identified for possible relocation in the Project area. On-farm canals and drains were visible on the LiDAR imagery (Central Valley Floodplain Evaluation and Delineation [CVFED] 2009) and/or identified during on-site field meetings with landowners. No canals or drains outside the Project footprint have been identified for redesign. Some portions of canals and drains could be discontinued in the future; the extent of discontinued and replaced canals will be considered during landowner negotiations. No subsurface drains were able to be quantified; however, some are believed to exist within the area.

2.18.3 Lift Pumps

Ten lift pumps were identified for possible relocation in the Project area. Lift pumps visible on the LiDAR imagery (CVFED 2009) or noted in the CalFish Passage Assessment Database (CalFish 2014) were assumed to require relocation to new facilities on the edge of the proposed levees. A pilot channel dug from the low flow river channel to the intake of the relocated pumps was also assumed. Locations in the CalFish Passage Assessment database were confirmed using the LiDAR imagery when possible.

2.18.4 Groundwater Wells

Thirty-two (32) groundwater wells were identified for possible floodproofing or relocation in the Project area, including the city of Mendota groundwater wells. Wells were identified within the area using aerial photography. During design, the DWR well database would be consulted to find abandoned wells that have not been destroyed, so that these old wells could be filled in to prevent a flood water conduit to the groundwater. A formal well canvas would also be conducted. Floodproofed wells would be provided with year-round vehicular access via a raised roadbed across the floodplain. The roadbed could include multiple culverts to support floodplain connectivity, depending on the length of the access road and its effect on floodplain flows. Wells relocated by the Project would provide equal utility. Wells taken out of service by the Project would be abandoned in accordance with U.S. Environmental Protection Agency (EPA), DWR and/or local regulations.

The levee alignment has been designed so that two of the city of Mendota's three groundwater wells located on the south side of the San Joaquin River to the east of Fresno Slough will be outside of the levees and floodplain area, and unaffected by the project. The remaining well is inside the levee and right next to the river, and will be floodproofed. The setback levee will be extended around the groundwater well to allow access and prevent flooding.

2.18.5 Oil and Gas Wells

Two closed or active oil and gas wells have been identified within the Project area for potential closure, relocation, or buyout. If active oil and gas wells cannot be avoided, the destruction or closure of those wells would be conducted in accordance with the California Department of Conservation, Division of Oil, Gas, and Geothermal Resources (DOGGR) regulations.

2.18.6 Other Utilities

Other infrastructure was identified within the impacted areas. These other facilities include high voltage transmission lines and water pipelines. High voltage transmission lines are assumed to be high enough to not be impacted. Water pipelines were quantified from existing maps and discussions with landowners. Water pipelines may be relocated or abandoned depending on their future use requirements. The city of Mendota has a water pipeline from their three groundwater wells that crosses Mowry Bridge. This pipeline may need to be modified as the setback levee will cross it, and a new bridge may be constructed immediately adjacent to the Mowry Bridge for construction access. Service line crossings (e.g., gas, water, electrical) would be considered during levee design.

2.19 Construction Access

Access for vehicles carrying materials, equipment, and personnel to and from the construction area would be provided via several existing roadways in the Project vicinity (see Figure 2-11). Improvements may be required to upgrade roadways, pavements, and crossings for anticipated construction traffic and loads, provide adequate turning radii and site distances, and to control dust on non-paved roads.

Anticipated improvements include:

- Eastside Drive – Approximately 0.6 mile of dirt road starting at Road 10 ½ will likely require overlaying, and the implementation of dust control measures.
- Chowchilla Canal Road/Road 13 – Approximately 0.3 mile of road starting at Eastside Drive will likely require some overlaying and the implementation of dust control measures.
- San Mateo Avenue – Approximately 0.5 mile of gravel and 1.5 miles of oil-dirt road starting at the existing San Joaquin River levees will likely require some overlying and the implementation of dust control measures.
- Bass Avenue Canal Crossings – These crossings may need additional bracing and shoring to ensure that they will be able to support the load of the construction equipment and activities. All the construction equipment on Bass Avenue will be within the legal loads (see note below). This crossing is on the Fresno County replacement list.
- Delta-Mendota Canal Crossing – This crossing may need additional bracing and supports to ensure that it will be able to support the load of the construction equipment activities.
- Mowry Bridge – This bridge is currently condemned due to beaver activity. A new bridge may be constructed immediately adjacent to it for construction access.

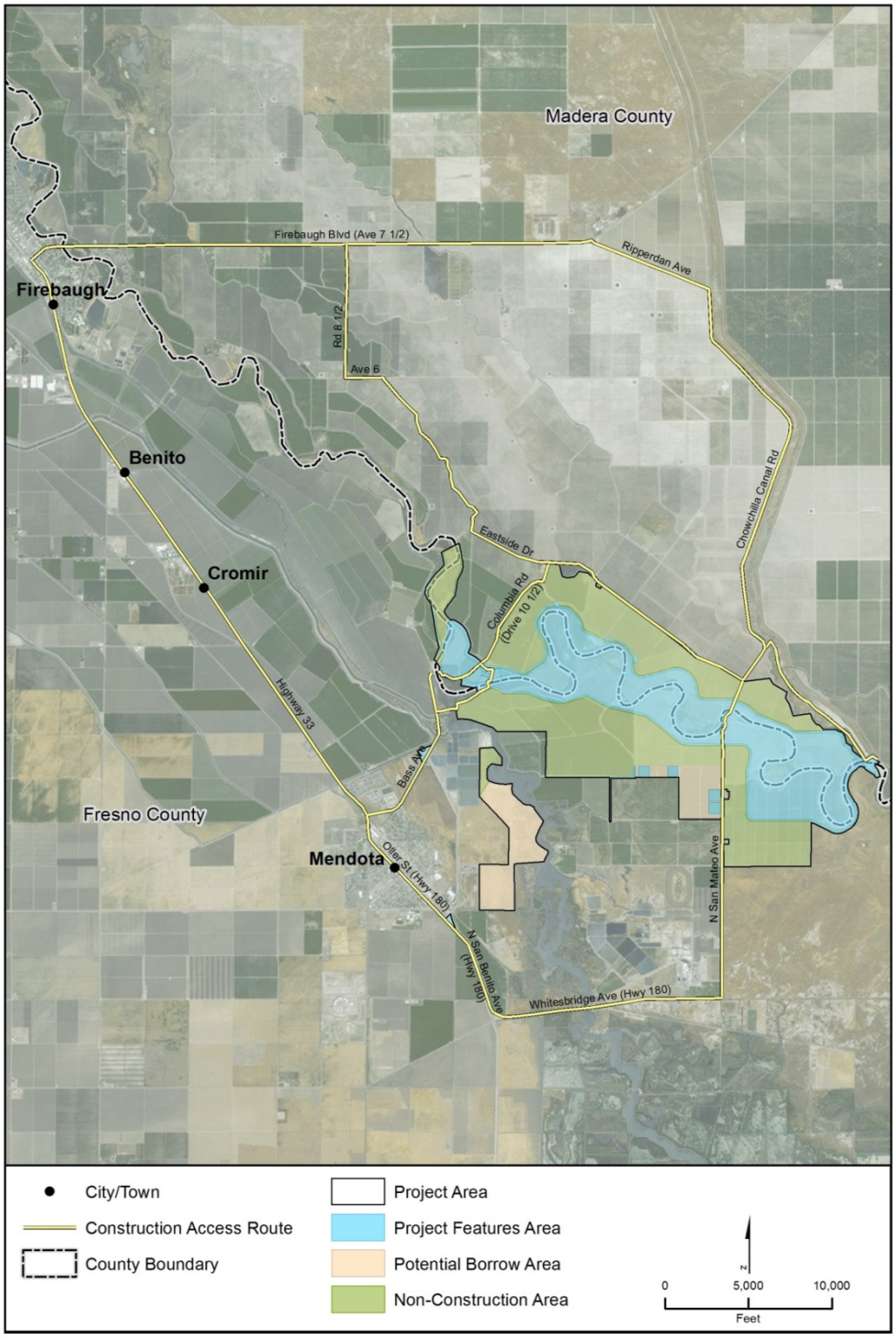


Figure 2-11.
Construction Access Routes

Dust control measures for non-paved roads could include the use of water trucks or dust palliative for dust control or gravel placement where necessary. Legal loads would be used on all roads, and once construction is completed, the roads would be returned to the same condition as they were prior to the Project.

2.20 Revegetation of Temporary Disturbance Areas

Areas temporarily disturbed during construction would be restored to their 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. Staging and borrow areas will occur on annual cropland or land purchased for the Project and not on permanent cropland outside of the Project levees.

2.21 Operations and Maintenance

The Project includes long-term operations and maintenance of the proposed facilities and features as described below.

2.21.1 Maintenance

Levees will require maintenance for vegetation management, access roads, levee inspections, levee restoration, rodent control, minor structures, encroachment removal, levee patrolling during flood events, and equipment. Levee vegetation management includes equipment to drag or mow the levee banks or aquatic-safe herbicide applications. Maintenance of access roads includes replacing gravel or scraping and filling of ruts to keep the roads in good condition. Levee restoration includes restoring areas with erosion or settlement problems or adding armor. Minor structures maintenance includes repair or replacement of gates, locks or fences. Encroachment removal involves removing illegally dumped materials.

Floodplain maintenance includes vegetation management for invasive species, periodic floodplain and channel shaping to retain capacity and prevent fish stranding, and other floodplain maintenance activities such as debris removal and repair of channel banks and bank protection measures.

Control structure maintenance includes 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. Work needed for the radial gates includes inspection of gates and seals and periodic replacement of seals. Work needed for the trash rack includes periodic repair or replacement of components, inspecting for operation, and greasing and inspecting the motors.

Fish screen maintenance is needed to ensure that screens are functioning to NMFS standards and capable of diverting the required flow. Fish screen maintenance includes removing the screens for cleaning, replacing screens when needed, periodic repair or replacement of brush cleaning

system components, periodic repair or replacement of trash rack components, inspection for operation, greasing and inspecting motors, and in-channel sediment removal in the structure vicinity.

Fish passage facility maintenance is needed to ensure that the passage facility is functioning to NMFS standards. Depending on the type of fish passage facility built, fish passage facility maintenance could include removing sediment and debris from the facility, in-channel sediment removal in the structure vicinity, inspection of gates and seals and periodic replacement of seals, periodic repair or replacement of weir gates, periodic repair or replacement of supplementary water system components, inspection for operation, greasing and inspecting motors, and replacement of riprap, grouting, boulders, large woody debris, or other "natural" features of the fish passage facility.

Seepage control measure maintenance is dependent on the type of measures implemented but could include activities such as periodic sediment removal and channel re-shaping for interceptor ditches, cleaning or flushing of interceptor drains, repair and replacement of pump parts for seepage wells and lift pumps, and vegetation management, berm restoration, and rodent control for seepage berms. If 15-foot-deep slurry walls are constructed at all setback levees, as expected in the Compact Bypass area, maintenance efforts associated with the seepage control measure is expected to be minimal.

Levee and structure protection maintenance includes repair of protection measures due to erosion or degradation and vegetation management.

Water diversion canal maintenance includes sediment removal and channel re-shaping.

2.21.2 Maintenance Schedule

All maintenance activities, when possible, would be timed to minimize the impacts to fish. Access and safety concerns, as well as timing of flows, may affect timing of the maintenance activities.

Maintenance of levees and floodplains with aquatic-safe herbicide treatment would occur sometime between spring and fall and would depend on the plant species that are being treated. Typically the herbicide would be administered prior to the plant going to seed and may need to be sprayed more than once. Disking for vegetation management usually occurs twice within the year; once in early spring after the rainfall season and then again in late summer prior to plants going to seed. Access road and levee restoration work would likely be done in the summer after the rainfall season, and timing and projects would be dependent on environmental clearance for small mammals, nesting birds or burrowing owls, and other wildlife species. Rodent trapping would likely be done by a pest control advisor. Rodenticide would not be used in the traps and rodent traps would be checked frequently for non-target species. All levee and floodplain work can be impacted by the presence of nesting birds, so in some areas work may not begin until the nesting birds have fledged or if there is some other biological reason to believe that the maintenance activities would not impact the nesting birds.

Timing of the maintenance of structures within the waterways would depend on the flow hydrograph and forecasted flows, but can typically be expected in the summer/fall after high

spring flows have receded. Cleaning of the in-channel structures would typically occur when flows are low enough to allow crews and equipment to enter the river safely to access the structures.

Debris that collects on trash racks, screens, ladders, or other fish passage structures will need to be periodically removed but will likely be scheduled based on the operation permits for these structures. Annual maintenance cleaning would be expected after the fish migration, but will need to be timed when flows have receded.

Lubing and annual gate maintenance would likely be in the late summer or early fall prior to winter and spring flows to make sure the structures are operating properly and to provide time for repairs and ordering parts if needed.

Water diversion canals that require maintenance could be isolated from the river system by closing the headgates at the canals which will not impact fish migration.

2.21.3 Operations

There are no operations for levees, floodplains, or levee and structure protection.

Control structure operations include operating the motors for the control gates, inspecting and assessing the gates, adjusting the gates for various stages of flows, adding short walls to the stop-log guides after years of subsidence, and running the automatic trash sweep.

Columbia Canal intake structure operations include removal of sediment in the sediment collection basin and running the automatic trash sweep.

Fish screen operations could occur every day when diversions are occurring. Operations include visually inspecting screens, verifying flow, clearing obstructions and debris, adjusting the baffles, permitting and regulatory compliance measures, estimating performance (i.e., velocity measurements), powering the screen, running the pumps for the sediment removal system, running automatic brush cleaning and trash rake motors, and running pumps for the fish diversion pipe. Operations also could include methods to reduce predation of juvenile fish (e.g., noise systems to scatter predators, netting, and periodic draining of the screen return pipes) and may include the addition of juvenile and/or adult fish traps.

Fish passage facility operations could occur every day during fish migration. Operations include visually inspecting the facility, verifying flow, clearing obstructions and debris, adjusting the weirs, permitting and regulatory compliance measures, estimating performance (i.e., velocity measurements), fish monitoring, and powering mechanically controlled weirs.

Seepage control measure operations are primarily passive, but seepage well operations would include running the pumps to lower the water table, and interceptor drain and ditch operations could involve running lift pumps.

2.22 Monitoring Activities

Monitoring activities would include physical and nonphysical activities within the Project area. Several monitoring components would be covered by the Program's *Physical Monitoring and Management Plan* (PEIS/R pages 2-49 to 2-52, and Appendix D.1, SJRRP 2011a), which provides guidelines for observing conditions as well as adjusting to changes in physical conditions within the Project area. The Program's *Physical Monitoring and Management Plan* consists of multiple component plans, addressing physical conditions such as flow, groundwater seepage, channel capacity, and propagation of native vegetation. Each component plan identifies objectives for the physical conditions within the Project area, and provides guidelines for the monitoring and management of those conditions. The component plans identify potential actions that could be taken to further enhance the achievement of the objectives. Finally, the Plan includes a description of monitoring activities which apply to one or more of the component plans. The component plans include the following monitoring objectives, all of which are identified in the Program's *Physical Monitoring and Management Plan*:

- **Flow** – To ensure compliance with the hydrograph releases in Exhibit B of the Settlement and any other applicable flow releases (e.g., buffer flows) (detail is provided in the Program's *Restoration Flow Guidelines*).
- **Seepage** – To reduce or avoid adverse or undesirable seepage impacts (detail is provided in the Program's *Seepage Management Plan*).
- **Channel capacity** – To maintain flood conveyance capacity (detail is provided in the Program's *Channel Capacity Report*).
- **Native vegetation** – To establish and maintain native riparian habitat.

Project specific components of the monitoring will include addressing effectiveness monitoring of fish screens, if constructed, and fish passage at structures within the Project area. The monitoring objective is the following:

- **Passage and screening effectiveness** – To maintain effective fish passage and fish screening at structures and diversions.

Monitoring activities, as they are described in the Program's *Physical Monitoring and Management Plan*, are guidelines for monitoring and could change during Project implementation. Monitoring activities in Reach 2B could include the following Program-level activities:

- **Flow monitoring** – Flow, cross sections, and surface water stage at gaging stations, and at additional locations during high-flow events.
- **Groundwater level monitoring** – Groundwater elevation in monitoring wells (detail is provided in the Program's *Seepage Management Plan*).
- **Aerial and topographic surveys** – True color aerial photographs and topographic surveys to assess river stage, hydraulic roughness, river width, bed elevation, and vegetation conditions.
- **Vegetation surveys** – Surveys of seed dispersal start and peak times, and native riparian vegetation establishment.

- **Sediment mobilization monitoring** – Sediment mobilization, bar formation, and bank erosion through aerial and topographic surveys of areas with elevated erosion potential (detail is provided in the Program's *Sediment Management Plan*).

Project specific monitoring activities will include the following:

- **Passage and screening effectiveness** – Flow, cross-sections, water surface, and velocity measurements near and within structures that provide passage or screening. Fish counting devices and rotary screw traps to count and measure fish passage and fish size.

2.23 Structure Design and Subsidence

All design work would be completed in general accordance with Reclamation Design Standards, applicable design codes, and commonly accepted industry standards. Where design criteria are missing for a specific project element, either Reclamation would be consulted for design specifications or standard engineering practice methods would be employed.

In addition, ground subsidence effects are anticipated to be experienced in the Project area. Based on subsidence data collected from December 2011 to July of 2015, Reclamation is designing this Project for 5 feet of subsidence, which is equal to the current rate for 25 years. In 2042 (25 years from the start of construction of this Project) the Sustainable Groundwater Management Act requires Groundwater Sustainability Agencies to have reached sustainable levels of withdrawal in all State groundwater basins, presumably meaning subsidence will have stopped. Methods to mitigate this anticipated ground subsidence include additional freeboard on levees, additional height of control structures and intake facilities, and additional stoplogs or concrete walls to maintain the same low flow elevation after years of subsidence on control structures.

2.24 Land Acquisition

The approximate amount of additional lands to be acquired to accommodate the floodplain, levees, bypass channel, structures, and borrow was quantified based on parcel data in GIS shapefile format from Fresno and Madera counties. Since remaining portions of parcels that fall outside the Project area may not be as easily utilized by the land owners, the entire parcels were considered, where appropriate.

2.25 Implementation Schedule

The Project implementation schedule contemplates building selected components of the Project in separate construction phases, allowing Project funding to be secured over time. Currently the bypass channel and associated structures are planned for construction first (fiscal year 2016 to 2019), followed by the Reach 2B setback levees and floodplain grading (fiscal year 2020 to 2024). Exact scheduling would be developed during the detailed design phase of the selected alternative.

2.26 Construction Considerations

The total construction timeline for the Project is currently estimated to range approximately from 106 to 157 months (9 to 13 years). Opportunities to shorten the overall schedule through construction efficiencies will be studied during the detailed design process.

Soil improvements for possible liquefiable soils may be required to protect proposed structures from damage or failure during an earthquake. All proposed structures would be designed to account for potential liquefaction. Soil improvements could include removing and replacing soils with adequate materials, injecting soil-cement slurry, vibrofloatation, dynamic compaction, structural foundation piles (stone or reinforced concrete), and other techniques.[2]

Flow in the San Joaquin River, operations at the existing Mendota Dam, operations at the Chowchilla Bifurcation Structure, and operation of the existing Columbia Canal must be maintained during construction. The majority of the Compact Bypass channel would be constructed without interruption to the San Joaquin River flow or the Columbia Canal, by conducting the excavation in the dry and constructing the Compact Bypass Control Structure last.

The construction of the Mendota Pool Control Structure across the existing river channel would require removable cofferdams in two phases to facilitate the construction without blocking the flow. If flow is present in the river during the construction period, flow would be diverted around the work area via a temporary diversion pipe or canal and fish passage would be provided. Cofferdams include two rows of braced sheet piling filled with dirt for stability and seepage control. The total height of the cofferdam is assumed to be 24 feet of which 12 feet would be above the channel bed. The control structures to be constructed on dry land (e.g., the Compact Bypass Control Structure) would not require cofferdams.

Stone slope protection (riprap) would be provided on the upstream and downstream slopes of the control structure embankment including some portions of the side slopes of the channel itself to prevent scouring. Riprap would be placed on bedding over geotextile fabric. Riprap would be filled with soil and planted with native vegetation.

Construction of the fish screen, which is located in the San Joaquin River, would require removable cofferdams in two phases to facilitate the construction without blocking the flow. The exception to this is the return/bypass fish pipes and outlet, which would take place in the dry using conventional construction methods. All fish facility structures and pipes with surfaces exposed to fish require additional attention to surface-smoothness.

For construction of the control structures and fish passage facilities, it will be necessary to maintain a minimum flow during construction during fish migration periods; the amount or range of flows during construction has not yet been identified. The construction of the Compact Bypass channel would be undertaken in the dry. The levee between the Compact Bypass and the Mendota Pool would be one of the first components constructed, as it includes a cement-bentonite wall that would assist in dewatering the rest of the site. This cement-bentonite wall

[2] Vibrofloatation uses a vibrating probe that penetrates the soil and causes the grain structure to collapse and increase the density of the soil. Dynamic compaction involves dropping a heavy weight onto soil to compact it.

would extend around the site of the Compact Bypass Control Structure on existing land, providing dewatering for the construction of this structure as well. Soil would remain in the location of the Compact Bypass Control Structure until the entire bypass is graded, levees are constructed, and the bypass is revegetated, at which time the Compact Bypass Control Structure would be constructed. The pilot channel would be excavated when the Mendota Pool Control Structure is complete and flows will start passing through the Compact Bypass.

Demolition of the San Mateo Avenue crossing would be timed so that the lesser Restoration Flows (5 to 195 cfs) can be routed around the structure during demolition.

2.27 Summary

Table 2-3 summarizes the levees, relocations, land acquisition, and construction schedule associated with the Project based on design, field, and evaluation criteria data.

Table 2-3.
Levees, Relocations, and Land Acquisition

	Left Levee	Right Levee
Levee Length	8.1 miles	6.8 miles
Average Levee Height	5.6 feet	4.7 feet
Fill Volume	328,600 cubic yards	226,900 cubic yards

Relocations			
Electrical Distribution	48,500 feet	Barn/Shed	1
Gas Transmission	11,000 feet	Facility	1
Water Pipeline	41,000 feet	Groundwater Well	32
Canal	31,500 feet	Lift Pump	10
Culvert	1	Power Pole	162
Diversion	3	Dwelling	2

Land Acquisition and Construction Schedule	
Land Acquisition[1]	2,900 acres
Time to Build[2]	157 months

[1] Total acreage includes areas that are sovereign and public trust lands.

[2] Construction timeline does not include the time that would also be needed to complete the National Environmental Policy Act and California Environmental Quality Act documentation process, obtain permits, appraise and acquire land, and perform pre-construction surveys.

2.28 Conservation Measures

The Project includes conservation measures based on the Program's Conservation Strategy, developed with the USFWS, NMFS, and DFW, which would be implemented in a manner that is consistent with adopted conservation plans for sensitive species, and for wetland and riparian ecosystems of the Restoration Area. These measures address all potentially affected Federally-listed and/or State-listed species, and all other species identified by USFWS, NMFS, or DFW as candidates, sensitive, or special-status in local or regional plans, policies, or regulations. For individual actions under the Project, the applicable, feasible measures would guide development of action-specific conservation strategies. Final EIS/R Table 2-1 Fish Passage Design Criteria presents the elements of the Program's Conservation Strategy as applicable to the Project. The measures presented here are based on those presented in the PEIS/R (SJRRP 2011a, pages 2-55 to 2-79) but have been updated to be Project-specific and to include updates from the USFWS Biological Opinion for the Project.

Table 2-4.
Conservation Measures for Biological Resources That May Be Affected by Project Actions

Conservation Measure and Identifier	Applicable Habitat and/or Species, and Conservation Measure Description	Regulatory Agency
VELB	**Valley Elderberry Longhorn Beetle**	
VELB-1. Avoid and Minimize Effects to Species	Within 1 year before the commencement of ground-disturbing activities, a qualified biologist will identify any elderberry shrubs in the Project footprint. If elderberry shrubs are found on or adjacent to the construction Project footprint, if feasible, a 100-foot-wide avoidance buffer – measured from the dripline of the plant – will be established around elderberry shrubs with stems greater than 1 inch in diameter at ground level and will be clearly identified in the field by staking, flagging, or fencing. No activities will occur within the buffer areas and worker awareness training and biological monitoring will be conducted to ensure that avoidance measures are being implemented.	USFWS
BNLL	**Blunt-Nosed Leopard Lizard**	
BNLL-1. Avoid and Minimize Effects to Species	Within 1 year before the commencement of ground-disturbing activities protocol-level surveys will be conducted according to the *Blunt-Nosed Leopard Lizard Survey Protocols for the San Joaquin River Restoration Program* (USFWS 2009) on lands identified as potentially suitable for blunt-nosed leopard lizard, which consist of annual grassland and elderberry savannah habitats on the south side of the San Joaquin River near the Chowchilla Bifurcation Structure. If blunt-nosed leopard lizard is not detected within the Project area, additional avoidance, minimization, and compensation for this species will not be required. If blunt-nosed leopard lizard are detected within or adjacent to the Project area, additional avoidance and minimization measures, including measures that will avoid direct take of this species, will be developed in coordination with USFWS and DFW and implemented before ground-disturbing activities. Construction activities within blunt-nosed leopard lizard habitat will occur outside of the peak activity period (April to July). In addition, if blunt-nosed leopard lizard are detected within or adjacent to the Project area, Reclamation will stop all construction activities that will have the potential to impact the species and reinitiate consultation with USFWS, and BNLL-2 (Compensate for Loss of Habitat or Species) from the PEIS/R will be implemented.	USFWS DFW
PLANTS	**Other Special-Status Plants**	
PLANTS-1. Avoid and Minimize Effects	Within 1 year before the commencement of ground-disturbing activities, protocol-level surveys for the special-status plants that are applicable to Reach 2B, will be conducted in grassland, elderberry savannah, fresh emergent wetland, and wet herbaceous habitats by a qualified botanist, in accordance with *Protocols for Surveying and Evaluating Impacts to*	USFWS DFW

Table 2-4.
Conservation Measures for Biological Resources That May Be Affected by Project Actions

Conservation Measure and Identifier	Applicable Habitat and/or Species, and Conservation Measure Description	Regulatory Agency
to Special-Status Plants	*Special Status Native Plant Populations and Natural Communities* (DFW 2009). If detected, locations of special-status plant populations that can be avoided will be clearly identified in the field by staking, flagging, or fencing a minimum 100-foot-wide buffer around them before the commencement of ground disturbing activities. No activity will occur within the buffer area, and worker awareness training and biological monitoring will be conducted to ensure that avoidance measures are being implemented. If federally listed plants are detected within or adjacent to the Project area, additional avoidance and minimization measures, including measures that will avoid direct take of this species, will be developed in coordination with USFWS and DFW. In addition, if federally listed plants are detected within or adjacent to the Project area and complete avoidance is not possible, Reclamation will stop all construction activities that will have the potential to impact the species and reinitiate consultation with USFWS, and PLANTS-2 (Compensate for Loss of Special-Status Plants) from the PEIS/R will be implemented. If federally listed plants are not detected within or adjacent to the Project area, additional avoidance, minimization, and compensation will not be required.	
GGS	**Giant Garter Snake**	
GGS-1. Avoid and Minimize Loss of Habitat for Giant Garter Snake	For work that would occur during the active season for giant garter snakes (between May 1 and October 1), preconstruction surveys will be completed by a qualified biologist approved by USFWS and DFW within a 24-hour period before any ground disturbance of potential giant garter snake habitat. If ground-disturbing activities stop on the Project site for a period of 2 weeks or more, a new giant garter snake survey will be completed no more than 24 hours before the restart of ground-disturbing activities. Avoidance of suitable giant garter snake habitat, as defined by USFWS (USFWS 1999a) and DFW, will occur, where feasible, by demarcating and maintaining a 300-foot-wide buffer around these areas. To the extent feasible, all activity involving disturbance of potential giant garter snake habitat will be restricted to the active season for giant garter snakes (between May 1 and October 1). For Project activities that cannot feasibly occur within this window, a cofferdam will be constructed in coordination with USFWS and work will be conducted in the dried area. If cofferdam construction is infeasible, work will be conducted during one active season (May 1 to October 1) and the following inactive season. Exclusion fencing, and increased monitoring of wintering sites will occur in coordination with USFWS during this inactive period construction. Construction will be minimized within 200 feet of banks of habitat, especially during the inactive period (Oct 2 to April 30) and movement of heavy equipment will be confined to existing roadways, to the extent feasible. Stockpiles and staging areas will be established more than 200 feet from the bank/edge of aquatic habitat. Clearing will be confined to the contractor use area which will be considered the minimal area necessary to facilitate construction activities. Giant garter snake habitat within or adjacent to the Project will be flagged, staked, or fenced and designated as an Environmentally Sensitive Area. No activity will occur within this area, to the extent feasible, and USFWS-approved worker awareness training and biological monitoring will be conducted to ensure that avoidance measures are being implemented. Vegetation will be hand-cleared in areas where suitable giant garter snake habitat is documented to occur, based on mapping provided in the BA or future, USFWS-approved mapping. Exclusionary fencing with one-way exit funnels will be installed at least 1 month before activities to allow the species to passively leave the area and to prevent reentry into work zones, per USFWS and/or DFW guidance. If a giant garter snake is found during construction activities, USFWS, DFW, and the Project's biological monitor will immediately be notified. The biological monitor, or his/her assignee, will stop construction in the vicinity of the find and allow the snake to leave on its own. The monitor will remain in the area for the remainder of the work day to ensure	Reclamation USFWS DFW

Table 2-4.
Conservation Measures for Biological Resources That May Be Affected by Project Actions

<table>
<tr><th>Conservation Measure and Identifier</th><th>Applicable Habitat and/or Species, and Conservation Measure Description</th><th>Regulatory Agency</th></tr>
<tr><td></td><td>the snake is not harmed. Escape routes for giant garter snake will be determined in advance of construction and snakes will be allowed to leave on their own. If a giant garter snake does not leave on its own within 1 working day, USFWS will be consulted and actions will be coordinated with DFW.
All construction-related excavations will be covered to prevent entrapment of individuals. Where applicable, construction areas will be dewatered 2 weeks before the start of activities to allow giant garter snakes and their prey to move out of the area before any disturbance.
Any plugging or collapsing of small mammal borrows on levee structures within 200 feet of giant garter snake aquatic habitat will be done during the active season (between May 1 and October 1). Prior to the action, the burrow entrance will be either fitted with a one way door mechanism that would allow snakes to exit the burrow, but not re-enter, or the burrow would be thoroughly examined using an appropriate scoping system that could reach the fullest extent of the burrow. This conservation measure will be included in all future levee maintenance actions.</td><td></td></tr>
<tr><td>GGS-2. Compensate for Temporary or Permanent Loss of Habitat</td><td>Temporarily affected giant garter snake aquatic habitat will be restored in accordance with criteria listed in the USFWS Mitigation Criteria for Restoration and/or Replacement of Giant Garter Snake Habitat (Appendix A to Programmatic Formal Consultation for U.S. Army Corps of Engineers 404 Permitted Projects with Relatively Small Effects on the Giant Garter Snake Within Butte, Colusa, Glenn, Fresno, Merced, Sacramento, San Joaquin, Solano, Stanislaus, Sutter, and Yolo Counties, California (USFWS 1997)), or the most current criteria from USFWS or DFW.
Permanent loss of giant garter snake habitat will be compensated at a ratio and in a manner that has been consulted on with USFWS and coordinated with DFW and may include dedication of conservation easements, purchase of credits at a USFWS-approved mitigation bank in sufficient quantity to compensate for the effect, and/or other off-site conservation measures.
Protocol-level trapping surveys and detailed habitat mapping will be conducted in suitable habitat for giant garter snake in 2016. These surveys will be conducted by a biologist permitted by both USFWS and DFW, and in accordance with survey protocols approved by both agencies.
If giant garter snake is detected during the 2016 trapping surveys, a pre-construction trapping survey will be conducted within the appropriate work areas and giant garter snakes will be relocated to a nearby, safe location outside of harm's way (likely either within Fresno Slough or Mendota Pool) prior to construction, in consultation with USFWS and coordination with DFW (note that only appropriately permitted individuals may handle listed species). If simply moving the snakes outside of the immediate area of disturbance is not feasible, then a relocation plan will be developed for longer-distance relocations (e.g., Volta Wildlife Area). The relocation plan will include information such as relocation methods, disease control methods, a habitat and giant garter snake population assessment at the recipient site, and post relocation monitoring methods.
On-site and off-site compensatory mitigation will occur in both Fresno Slough and the Volta Wildlife Area, to provide benefits to both populations.
Compensatory mitigation will occur in all feasible locations of those identified below, up to a 3.5:1 replacement ratio for impacted acres identified as suitable habitat.
Giant Garter Snake- Extent of Potential Impacts and Estimated Mitigation Acreages
<table>
<tr><th>Anticipated GGS Impacts</th><th>Potential Impacts (acres)</th><th>Mitigation Target (acres)</th></tr>
<tr><td>Aquatic</td><td>142</td><td>423</td></tr>
<tr><td>Upland</td><td>221</td><td>848</td></tr>
<tr><td>TOTAL</td><td>363</td><td>1,271[1]</td></tr>
</table></td><td>USFWS
DFW</td></tr>
</table>

Table 2-4.
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Conservation Measure and Identifier	Applicable Habitat and/or Species, and Conservation Measure Description	Regulatory Agency
	[1] Amount may vary based on habitat availability and mitigation opportunities Compensatory mitigation will include: a. A new turn-key mitigation site, or sites, in Fresno Slough and/or b. A new turn-key mitigation site or purchase of credits at a mitigation bank near the Volta Wildlife Area. In addition to the above up to 3.5:1 acreage compensation, providing funding to assist the Volta Wildlife Area in developing additional water sources for giant garter snake habitat enhancement, constructing ridges for burrows in an existing area of habitat, or creating additional wetland habitat at the existing Volta Wildlife Area may be pursued to provide benefits to the existing population.	
WPT	**Western Pond Turtle**	
WPT-1. Avoid and Minimize Loss of Individuals	A qualified biologist will conduct surveys in aquatic habitats to be dewatered and/or filled during Project construction. Surveys will be conducted immediately after dewatering and before fill of aquatic habitat suitable for western pond turtles. If western pond turtles are found, the biologist will capture them and move them to nearby USFWS- and/or DFW-approved areas of suitable habitat that will not be disturbed by Project construction.	DFW
SWH	**Swainson's Hawk**	
SWH-1. Avoid and Minimize Impacts to Swainson's Hawk	Preconstruction surveys for active Swainson's hawk nests will be conducted in and around all potential nest trees within ½-mile of Project-related disturbance (including construction-related traffic). These surveys will be conducted in accordance with *the Recommended Timing and Methodology for Swainson's Hawk Nesting Surveys in California's Central Valley* (Swainson's Hawk Technical Advisory Committee 2000) or current guidance. If known or active nests are identified through preconstruction surveys or other means, a biological monitor will be on site when construction is occurring to monitor the nest. When possible, a ½-mile no-disturbance buffer will be established around all active nest sites if construction cannot be limited to occur outside the nesting season (February 15 through September 15). If it is not possible to maintain a ½-mile no-disturbance buffer, the biological monitor will determine the size of the buffer needed and which activities can proceed without impacting the nest, in coordination with DFW. If reduced buffers are used or limited activity is required within a buffer a qualified biologist will monitor the nest and advise Reclamation if behavioral impacts to the nest are observed, so that corrective action to protect the nest can be implemented. If a nest develops near ongoing construction activities after the activities were initiated a biological monitor will observe the nest and implement a buffer or limit activity near the nest to the degree necessary to prevent construction from negatively affecting the nest. Worker awareness training and biological monitoring will be conducted to ensure that avoidance measures are being implemented.	DFW
SWH-2. Compensate for Loss of Nest Trees and Foraging Habitat	If foraging habitat for Swainson's hawk is removed in association with Project implementation and impacted foraging habitat is not replaced with an equal or greater amount of suitable foraging habitat in the completed Project area, foraging habitat compensation will occur in coordination with DFW. Foraging habitat mitigation may consist of planting and establishing alfalfa, row crops, pasture, fallow fields, or other habitats considered to be Swainson's hawk foraging habitat in the Project impact calculations. If potential nesting trees are to be removed during construction activities, removal will take place outside of Swainson's hawk nesting season. If impacted Swainson's hawk nesting habitat is not replaced with an equal or greater amount of suitable nesting habitat in the completed Project area, the Project proponent will develop a plan to replace known Swainson's hawk nest trees with a number of equivalent native trees that were previously determined to be impacts in coordination with DFW. If necessary, compensation will	DFW

Table 2-4.
Conservation Measures for Biological Resources That May Be Affected by Project Actions

Conservation Measure and Identifier	Applicable Habitat and/or Species, and Conservation Measure Description	Regulatory Agency
	include dedication of conservation easements, purchase of mitigation credits, or other off-site conservation measures, and the details of these measures will be included in the mitigation plan and must occur with full endowments for management in perpetuity. The plan will include information on responsible parties for long-term management, holders of conservations easements, long-term management requirements, and other details, as appropriate, for the preservation of long-term viable populations.	
RAPTOR	**Other Nesting Raptors**	
RAPTOR-1. Avoid and Minimize Loss of Individual Raptors	If nesting raptors are determined to be present, construction activity, including vegetation removal, will only occur outside the typical breeding season for raptors (vegetation removal from September 16 to January 31), if feasible. If Project related activities must occur during the breeding season (February through mid-September) for non-listed raptors, surveys for active nests will be conducted by a qualified biologist no more than 30 days prior to commencing Project-related activities. If active nests are located in the Project footprint, a no-disturbance buffer of 500 feet will be established until a qualified biologist determines that the bird(s) have fledged and are no longer reliant upon the nest or parental care for survival, to the extent feasible. No activity will occur within the buffer area, to the extent feasible, and worker awareness training and biological monitoring will be conducted to ensure that avoidance measures are being implemented. A smaller buffer may be considered by a qualified biologist and in coordination with DFW based on the sensitivity of the resource, the type of disturbance activity, and nesting stage, particularly if a nest is established while construction is already underway or if a particular nest is found to be less sensitive to construction activities. If reduced buffers are used or limited activity is required within a buffer a qualified biologist will monitor the nest and advise Reclamation if behavioral impacts to the nest are observed, so that corrective action to protect the nest can be implemented.	DFW
RAPTOR-2. Compensate for Loss of Nest Trees	Native trees removed during Project activities will be replaced with an appropriate number of native trees as determined by Reclamation in coordination with DFW.	DFW
RNB	**Riparian Nesting Birds: Least Bell's Vireo**	
RNB-1. Avoid and Minimize Effects to Species	Prior to ground disturbance, a qualified biologist will conduct surveys for least Bell's vireo in all riparian habitats within 500 feet of ground-disturbing activities at the start of the spring nesting season adhering to guidance offered in *Least Bell's Vireo Survey Guidelines* (USFWS 2001). If full protocol surveys cannot be implemented prior to initiation of ground-disturbing activities, the monitoring biologist approved by USFWS will be present for all activities within 500 feet of potentially suitable habitat. The monitoring biologist will perform a minimum of three focused surveys on three separate days prior to ground disturbance to determine the presence of least Bell's vireo, nest building, egg incubation, or brood rearing activities within 500 feet of the project footprint. The surveys will begin a maximum of 7 days prior to project construction and one survey will be conducted the day before ground disturbance. If any least Bell's vireo are detected, Reclamation will postpone work within 500 feet of the location and contact USFWS within 24 hours. Upon notification, USFWS will discuss the best approach to avoid/minimize impacts to nesting least Bell's vireo and a nest monitoring program acceptable to USFWS. Subsequent to these discussions, work may be initiated subject to implementation of the agreed upon avoidance/minimization approach and nest monitoring program. In addition, if least Bell's vireo are detected in the Project area, Reclamation will stop all construction activities that will have the potential to impact the species and reinitiate consultation with USFWS, and RNB-2 (Compensate for Loss of Habitat or Species) from the PEIS/R will be implemented.	USFWS DFW

Table 2-4.
Conservation Measures for Biological Resources That May Be Affected by Project Actions

Conservation Measure and Identifier	Applicable Habitat and/or Species, and Conservation Measure Description	Regulatory Agency
	If least Bell's vireo is not detected in riparian habitats within 500 feet of ground-disturbing activities, additional avoidance, minimization, and compensation for this species will not be required.	
MBTA	**Other Birds Protected by the Migratory Bird Treaty Act**	
MBTA-1. Avoid and Minimize Effects to Species	Native nesting birds will be avoided by not conducting Project activity, including vegetation removal, during the typical breeding season (February 1 to September 1), if species covered under the Migratory Bird Treaty Act and Fish and Game Code sections 3503, 3503.5, and 3513 are determined to be nesting, to the extent feasible. Vegetation removal will be limited to the areas necessary for construction. If Project-related activities must occur during the breeding season (February 1 through September 1) for birds protected by the Migratory Bird Treaty Act, surveys for active nests, including ground nesting birds, will be conducted by a qualified biologist no more than 30 days prior to commencing Project-related activities. If active nests are identified a biological monitor will be on site when construction is occurring to monitor impacts to the nest. If necessary, buffers adequate to protect the nest will be established and activities that may disrupt nesting behavior will be avoided within the buffer until the breeding season has ended or until a qualified biologist has determined that the birds have fledged and are no longer reliant upon the nest or parental care for survival. If a nest develops near ongoing construction activities after the activities were initiated a biological monitor will observe the nest and implement a buffer or limit activity near the nest to the degree necessary to prevent construction from negatively affecting the nest. An Avian Protection Plan will be established in coordination with USFWS and DFW. Any overhead utility companies within the Project area, whose lines, poles, or towers may be moved in association with the Project, will also be consulted as part of the Avian Protection Plan.	USFWS DFW
TRI	**Tricolored Blackbird**	
TRI-1. Avoid Nesting Colonies	Measures will be taken to protect nesting tricolored blackbirds during the nesting season (typically February 1-July 1). Special attention will be paid to row crops, alfalfa fields, and tule or cattail wetlands. If necessary, surveys will be conducted to identify any potential nesting colonies within 300 feet of construction activity. To the extent feasible, vegetation clearing (including in row crops and alfalfa fields) and short-term disturbances (e.g., construction traffic or activities lasting no more than 6 hours) will not be conducted within 60 feet of an active nest and prolonged construction activities will not be conducted within 300 feet of an active nest. If activities near nests cannot be avoided as described above, a biological monitor will observe the nests and any activities within these areas to determine the size of the buffer and the extent to which activities must be limited to prevent construction from negatively affecting nesting tricolored blackbirds. Because many tricolored blackbird nesting colonies expand over time, the extent of any breeding colony will be reassessed and buffers relocated as necessary. Nests will not be disturbed until a qualified biologist has confirmed that all young have fledged and are able to disperse from the breeding site. This will typically occur approximately 40 days after nest building begins.	USFWS DFW
SWA	**Cliff Swallow**	
SWA-1. Avoid Nesting Colonies	Measures will be taken to protect nesting cliff swallows (and other swallows) on existing structures (e.g., Chowchilla Bifurcation Structure) during the nesting season (typically February 15-September 1). Swallow nests on existing structures will not be removed or disturbed during the nesting season. If work at or within 150 feet of swallow nests is anticipated to begin during the nesting season, all swallow nests will be removed outside of the nesting season and measures will be taken to prevent swallows from accessing the structure and building new nests when the nesting season begins. If exclusion is necessary an exclusion plan will be submitted to USFWS and DFW for review 30 days	USFWS DFW

Table 2-4.
Conservation Measures for Biological Resources That May Be Affected by Project Actions

Conservation Measure and Identifier	Applicable Habitat and/or Species, and Conservation Measure Description	Regulatory Agency
	prior to implementation. Measures to prevent swallows from building nests may include exclusion with use of netting, blocking the entrance or access to the nest habitat with wood, plastic, vinyl, or other materials, or covering nest attachment sites with polytetrafluoroethylene (PTFE, commonly called Teflon). If only that section of a structure where swallows have nested in the past is netted, the swallows will often choose alternative sites on the same structure. Therefore, any part of a structure suitable for nesting must be addressed. After the measures are installed, the area will be monitored for entry points and necessary adjustments will be made. If work near a structure that will not directly affect the structure begins prior to the nesting season and swallows nest near the ongoing construction work, then it will be assumed that the swallows are not bothered by the work, the work can continue, and exclusion is not necessary. Work near a structure with swallow nests that will not directly affect the structure may be initiated during the nesting season if a biological monitor determines that the work is not disrupting nesting activities. In these cases, use of visual blinds or buffers between construction work and the nests may be helpful to protect the nests.	
BRO	**Burrowing Owl**	
BRO-1. Avoid Loss of Individuals	Preconstruction surveys for burrowing owls will be conducted in areas supporting potentially suitable habitat and within 30 days before the start of construction activities. If ground-disturbing activities are delayed or suspended for more than 30 days after the preconstruction survey, the site will be resurveyed. These surveys and mitigation will be conducted in accordance with the *Staff Report on Burrowing Owl Mitigation* (DFW 2012), or current guidance. Occupied burrows will not be disturbed during the breeding season (February 1 through August 31). Buffers to protect occupied burrows will be established consistent with the *Staff Report on Burrowing Owl Mitigation* (DFW 2012). Buffer size will vary based on the time of year and level of disturbance. Between April 1 and October 15 buffers will be between 200 to 500 meters depending on level of disturbance. Between October 16 and March 31 buffers will be between 50 and 500 meters depending on the level of disturbance. Ground-disturbing activities will not occur within the designated buffers, to the extent feasible. A smaller buffer may be considered by a qualified biologist and in coordination with DFW based on the sensitivity of the resource, the type of disturbance activity, and nesting stage, particularly if a nest is established while construction is already underway or if a particular nest is found to be less sensitive to construction activities. If reduced buffers are used or limited activity is required within a buffer a qualified biologist will monitor the nest and advise Reclamation if behavioral impacts to the nest are observed, so that corrective action to protect the nest can be implemented.	DFW
BRO-2. Minimize Impacts to Species	If it becomes necessary to evict burrowing owls from occupied burrows, passive owl relocation techniques must be implemented during the non-nesting season and a Burrowing Owl Exclusion Plan will be prepared and submitted to DFW describing how exclusion will occur and take will be avoided. If a DFW-approved biologist can verify through noninvasive methods that owls have not begun egg-laying and incubation, or that juveniles from occupied burrows are foraging independently and are capable of independent survival, a plan will be coordinated with DFW to offset burrow habitat and foraging areas on the Project site if burrows and foraging areas are taken by SJRRP actions. Mitigation measures will be consistent with the *Staff Report on Burrowing Owl Mitigation* (DFW 2012), or current guidance. If destruction of occupied burrows occurs, existing unsuitable burrows will be enhanced (enlarged or cleared of debris) or new burrows created. Replacement of occupied burrows with artificial burrows will occur at a ratio of 1 burrow collapsed to 1 artificial burrow constructed (1:1). This will be done in coordination with DFW.	DFW

Table 2-4.
Conservation Measures for Biological Resources That May Be Affected by Project Actions

Conservation Measure and Identifier	Applicable Habitat and/or Species, and Conservation Measure Description	Regulatory Agency
	Owls will be excluded from burrows in the immediate impact zone within a 160-foot-wide buffer zone by installing one-way doors in burrow entrances. These doors will be in place at least 48 hours before excavation to insure the owls have departed. The Project area will be monitored daily for 1 week to confirm owl departure from burrows before any ground-disturbing activities. Where possible, burrows will be excavated using hand tools and refilled to prevent reoccupation. Sections of flexible plastic pipe will be inserted into the tunnels during excavation to maintain an escape route for any animals inside the burrow.	
BAT	**Special-Status Bats**	
BAT-1. Avoid and Minimize Loss of Individuals	Prior to removal of potentially suitable roosting habitat for special-status bats (e.g., removal of buildings, modification of bridges), surveys for roosting bats on the Project site will be conducted by a qualified biologist. Surveys for bat species will be conducted no more than 14 days prior to ground disturbance and/or construction activities and during the appropriate time of day to maximize detectability. The type of survey will depend on the condition of the potential roosting habitat and may include visual surveys or use of acoustic detectors. Visual surveys may consist of a daytime pedestrian survey for evidence of bat use (e.g., guano) and/or an evening emergence survey for the presence or absence of bats. The type of survey will depend on the condition of the potential roosting habitat. If no bat roosts are found, then no further study is required. If evidence of bat use is observed, the number and species of bats using the roost will be determined. Bat detectors may be used to supplement survey efforts. If roosts are determined to be present and must be removed, the bats will be excluded from the roosting site before the facility is removed. A mitigation program addressing compensation, exclusion methods, and roost removal procedures will be developed in coordination with DFW before implementation. Exclusion plans will include methods to safely exclude roosting bats from the roosting structure to be removed, monitoring of the roost during eviction and a discussion of type, amount, and distance of suitable habitat near the habitat to be removed. Exclusion methods may include use of one-way doors at roost entrances (bats may leave, but not reenter), or sealing roost entrances when a site can be confirmed to contain no bats. Exclusion efforts may be restricted during periods of sensitive activity (e.g., during hibernation or while females in maternity colonies are nursing young).	DFW
BAT-2. Compensate for Loss of Habitat	The loss of each roost will be replaced, in coordination with DFW, and may include construction and installation of bat boxes suitable to the bat species and colony size excluded from the original roosting site. Roost replacement will be implemented before bats are excluded from the original roost sites. Once the replacement roosts are constructed and it is confirmed that bats are not present in the original roost sites, the structure may be removed.	DFW
FKR	**Fresno Kangaroo Rat**	
FKR-1. Avoid and Minimize Effects to Species	Preconstruction surveys will be conducted by a USFWS-approved biologist to determine if potential burrows for Fresno kangaroo rat are present in the Project footprint in annual grassland and elderberry savannah identified as potential Fresno kangaroo rat habitat on the south side of the San Joaquin River near the Chowchilla Bifurcation Structure. Surveys will be conducted well in advance of ground-disturbing activities. The biologist will conduct burrow searches by systematically walking transects, which will be adjusted based on vegetation height and topography, and in coordination with USFWS and DFW. Transects will be used to identify the presence of kangaroo rat burrows. When burrows are found within 100 feet of the Project footprint, focused live trapping surveys will be conducted by a biologist permitted to handle Fresno kangaroo rat by both the USFWS and DFW, and following a USFWS and DFW approved trapping plan.	USFWS DFW

Table 2-4.
Conservation Measures for Biological Resources That May Be Affected by Project Actions

Conservation Measure and Identifier	Applicable Habitat and/or Species, and Conservation Measure Description	Regulatory Agency
	If Fresno kangaroo rat are detected within or adjacent to the Project area, additional avoidance and minimization measures will be developed in coordination with USFWS and DFW, as appropriate, and construction activities will be conducted when they are least likely to affect the species (i.e., after the normal breeding season of December through September (Ahlborn 1999)). This timing will be coordinated with USFWS and DFW. In addition, if Fresno kangaroo rat are detected within or adjacent to the Project area, Reclamation will stop all construction activities that will have the potential to impact the species and reinitiate consultation with USFWS, and FKR-3 (Compensate for Loss of Habitat or Species) from the PEIS/R will be implemented. If Fresno kangaroo rat are not detected within or adjacent to the Project area, additional avoidance, minimization, and compensation will not be required.	
SJKF	**San Joaquin Kit Fox**	
SJKF-1. Avoid and Minimize Effects to Species	A qualified biologist will conduct preconstruction surveys in the Project area no less than 14 days and no more than 30 days before the commencement of ground-disturbing activities to identify potential dens more than 5 inches in diameter. Reclamation will implement USFWS' *Standardized Recommendations for Protection of San Joaquin Kit Fox Prior to or During Ground Disturbance* (USFWS 1999b). Reclamation will notify USFWS and DFW in writing of the results of the preconstruction survey within 30 days after these activities are completed. If San Joaquin kit fox are detected within or adjacent to the Project area, additional avoidance and minimization measures, including measures that will avoid direct take of this species, will be developed in coordination with USFWS and DFW and implemented before ground disturbing-activities. If dens are located within the proposed work area, and cannot be avoided during construction activities, a USFWS-approved biologist will determine if the dens are occupied. Reclamation will present the results of preactivity den searches within 5 days after these activities are completed and before the start of ground disturbing activities in the Project area. Reclamation will notify USFWS and DFW immediately if a natal or pupping den is found in the survey area. If occupied dens are present within the proposed work area, their disturbance and destruction will be avoided, to the fullest extent possible. Exclusion zones will be implemented following the latest USFWS procedures and construction activities will be conducted when they are least likely to affect the species (i.e., after the normal breeding season of December to April (Ahlborn 2000)). This timing will be coordinated with USFWS and DFW. In addition, if San Joaquin kit fox are detected within or adjacent to the Action Area, Reclamation will stop all construction activities that will have the potential to impact the species and reinitiate consultation with USFWS, and SJKF-2 (Compensate for Loss of Habitat or Species) from the PEIS/R will be implemented. If San Joaquin kit fox are not detected within or adjacent to the Project area, additional avoidance, minimization, and compensation will not be required.	USFWS DFW
PL	**Pacific Lamprey**	
PL-1. Avoid and Minimize Effects to Species	A qualified biologist will conduct preconstruction surveys as outlined in Attachment A of USFWS' *Best Management Practices to Minimize Adverse Effects to Pacific Lamprey* (*Entosphenus tridentatus*) (2010). Work in documented areas of Pacific lamprey presence will be timed to avoid in-channel work during typical lamprey spawning (March 1 to July 1), to the extent feasible. If temporary dewatering in documented areas of lamprey presence is required for instream channel work, salvage methods will be implemented to capture and move ammocoetes to a safe area, in consultation with USFWS.	USFWS

Table 2-4.
Conservation Measures for Biological Resources That May Be Affected by Project Actions

Conservation Measure and Identifier	Applicable Habitat and/or Species, and Conservation Measure Description	Regulatory Agency
RHSNC	**Riparian Habitat and Other Sensitive Natural Communities**	
RHSNC-1. Avoid and Minimize Loss of Riparian Habitat and Other Sensitive Natural Communities	Biological surveys have been conducted to identify, map, and quantify riparian and other sensitive habitats in potential construction areas. See Section 6.3.3. of the EIS/R. Construction activities will be avoided in areas containing sensitive natural communities, as appropriate.	DFW
RHSNC-2. Compensate for Loss of Riparian Habitat and Other Sensitive Natural Communities	The Riparian Habitat Mitigation and Monitoring Plan for the SJRRP is being developed and implemented in coordination with DFW. Credits for increased acreage or improved ecological function or riparian and wetland habitats resulting from the implementation of SJRRP actions will be applied as compensatory mitigation before additional compensatory measures are required. If losses of other sensitive natural communities (e.g., recognized as sensitive by CNDDB, but not protected under other regulations or policies) would not be offset by the benefits of the SJRRP, then additional compensation will be provided through creating, restoring, or preserving in perpetuity in-kind communities at a sufficient ratio for no net loss of habitat function or acreage. The appropriate ratio will be determined in coordination with USFWS, DFW, and/or the Corps, depending on agency jurisdiction.	DFW
WUS	**Waters of the United States/Waters of the State**	
WUS-1. Identify and Quantify Wetlands and Other Waters of the United States	The distribution of wetlands in the Project area is described in Section 15.3.3 of the EIS/R. That section of the EIS/R also describes the acreage of effects on waters of the United States, based on the mapped distribution of these wetlands, hydraulic modeling and field observation. A delineation of waters of the United States has been submitted to the Corps for verification. The delineation was conducted according to methods established in the Corps *Wetlands Delineation Manual* and *Arid West Supplement* (Corps Environmental Laboratory 1987, 2008). Construction and modification of road crossings, control structures, fish barriers, fish passages, and other structures will be designed to minimize effects on waters of the United States and waters of the State, and will employ BMPs to avoid indirect effects on water quality.	Corps
WUS-2. Obtain Permits and Compensate for Any Loss of Wetlands and Other Waters of the United States/Waters of the State	The Project proponent, in coordination with the Corps, will determine the acreage of effects on waters of the United States and waters of the State that will result from implementation of the SJRRP. The Project proponent will adhere to a "no net loss" basis for the acreage of wetlands and other waters of the United States and waters of the State that will be removed and/or degraded. Wetland habitat will be restored, enhanced, and/or replaced at acreages and locations and by methods agreed on by the Corps and the Central Valley RWQCB, and DFW, as appropriate, depending on agency jurisdiction. The Project proponent will obtain Section 404 and Section 401 (Clean Water Act) and Section 10 (Rivers and Harbors Act) permits and comply with all permit terms. The acreage, location, and methods for compensation will be determined during the Section 401 and Section 404 permitting processes. The compensation will be consistent with recommendations in the Fish and Wildlife Coordination Act Report.	Corps
INV	**Invasive Plants**	
INV-1. Implement the Invasive Vegetation Monitoring and	Reclamation will implement the Invasive Vegetation Monitoring and Management Plan for the SJRRP (Appendix L of the PEIS/R), which includes measures to monitor, control, and where possible eradicate, invasive plant infestations during flow releases and construction activities.	Reclamation

Table 2-4.
Conservation Measures for Biological Resources That May Be Affected by Project Actions

Conservation Measure and Identifier	Applicable Habitat and/or Species, and Conservation Measure Description	Regulatory Agency
Management Plan	The implementation of the Invasive Vegetation Monitoring and Management Plan (Appendix L of the PEIS/R) will include monitoring procedures, thresholds for management responses, success criteria, and adaptive management measures for controlling invasive plant species. The control of invasive weeds and other recommended actions in the Invasive Vegetation Monitoring and Management Plan (Appendix L of the PEIS/R) will be consistent with recommendations in the Fish and Wildlife Coordination Act Report.	
CP	**Conservation Plans**	
CP-1. Remain Consistent with Approved Conservation Plans	Facility siting and construction activities will be conducted in a manner consistent with the goals and strategies of adopted habitat conservation plans, natural community conservation plans, or other approved local, regional, or State habitat conservation plans to the extent feasible. Coordination will occur with USFWS and/or DFW, as appropriate.	USFWS DFW
CP-2. Compensate Effects Consistent with Approved Conservation Plans	The Project proponent will compensate effects consistent with applicable conservation plans and implement all applicable measures required by the plans.	USFWS DFW
CVS	**Central Valley Steelhead**	
CVS-1. Avoid Loss of Habitat and Risk of Take of Species	Impacts to habitat conditions (i.e., changes in flows potentially resulting in decreased flows in the tributaries, increases in temperature, increases in pollutant concentration, change in recirculation/recapture rates and methods, decrease in floodplain connectivity, removal of riparian vegetation, decreased in quality rearing habitat, etc.) are analyzed in consultation with NMFS. The Hills Ferry Barrier will be operated and maintained to exclude Central Valley steelhead from the Restoration Area during construction activities and until suitable habitat conditions are restored, and trapping and monitoring will occur to detect steelhead moving upstream and relocate them to the mouth of the Merced River. Maintenance of conservation measures will be conducted to the extent necessary to ensure that the overall long-term habitat effects of the Project are positive. Before construction, Reclamation will conduct an education program for all agency and contracted employees relative to the Federally listed species that may be encountered within the Project area, and required practices for their avoidance and protection. A NMFS-appointed representative will be identified to employees and contractors to ensure that questions regarding avoidance and protection measures are addressed in a timely manner. Disturbance of riparian vegetation will be avoided to the greatest extent practicable. A spill prevention plan will be prepared describing measures to be taken to minimize the risk of fluids or other materials used during construction (e.g., oils, transmission and hydraulic fluids, cement, fuel) from entering the San Joaquin River or contaminating riparian areas adjacent to the river itself. In addition to a spill prevention plan, a cleanup protocol will be developed before construction begins and will be implemented in case of a spill. Stockpiling of materials, including portable equipment, vehicles and supplies, such as chemicals, will be restricted to the designated construction staging areas, exclusive of any riparian and wetland areas. A qualified biological monitor will be present during all construction activities, including clearing, grubbing, pruning, and trimming of vegetation at each job site during	NMFS

Table 2-4.
Conservation Measures for Biological Resources That May Be Affected by Project Actions

Conservation Measure and Identifier	Applicable Habitat and/or Species, and Conservation Measure Description	Regulatory Agency
	construction initiation, midway through construction, and at the close of construction, to monitor implementation of conservation measures and water quality. The floodplain will be designed in accordance with the Rearing Habitat Design Objectives.	
CVS-2. Minimize Loss of Habitat and Risk of Take of Species	Construction BMPs for off-channel staging, and storage of equipment and vehicles, will be implemented to minimize the risk of contaminating the waters of the San Joaquin River by spilled materials. BMPs will also include minimization of erosion and stormwater runoff, as appropriate. Riparian vegetation removed or damaged will be replaced within the immediate area of the disturbance to maintain habitat quality. If individuals of listed species are observed present within the Project area, NMFS will be notified. NMFS personnel will have access to construction sites during construction, and following completion, to evaluate species presence and condition and/or habitat conditions. If bank stabilization activities are necessary, then such stabilization will be constructed to minimize predator habitat, minimize erosion potential, and contain material suitable for supporting riparian vegetation.	NMFS
EFH	**Essential Fish Habitat (Pacific Salmonids)**	
EFH-1. Avoid Loss of Habitat and Risk of Take of Species	Maintenance of conservation measures will be conducted to the extent necessary to ensure that the overall long-term habitat effects of the Project are positive. A NMFS-appointed representative will be identified to employees and contractors to ensure that questions regarding avoidance and protection measures are addressed in a timely manner. Disturbance of riparian vegetation will be avoided to the greatest extent practicable. A spill prevention plan will be prepared describing measures to be taken to minimize the risk of fluids or other materials used during construction (e.g., oils, transmission and hydraulic fluids, cement, fuel) from entering the San Joaquin River or contaminating riparian areas adjacent to the river itself. In addition to a spill prevention plan, a cleanup protocol will be developed before construction begins and will be implemented in case of a spill. Stockpiling of materials, including portable equipment, vehicles and supplies, such as chemicals, will be restricted to the designated construction staging areas, exclusive of any riparian and wetland areas. A qualified biological monitor will be present during all construction activities, including clearing, grubbing, pruning, and trimming of vegetation at each job site during construction initiation, midway through construction, and at the close of construction to monitor implementation of conservation measures and water quality. The bottom topography of the San Joaquin River channel will be designed to decrease or eliminate predator holding habitat.	NMFS

Table 2-4.
Conservation Measures for Biological Resources That May Be Affected by Project Actions

Conservation Measure and Identifier	Applicable Habitat and/or Species, and Conservation Measure Description	Regulatory Agency
EFH-2. Minimize Loss of Habitat and Risk of Take from Implementation of Construction Activities	Construction BMPs for off-channel staging and storage of equipment and vehicles will be implemented to minimize the risk of contaminating the waters of the San Joaquin River by spilled materials. BMPs will also include minimization of erosion and stormwater runoff, as appropriate. Riparian vegetation removed or damaged will be replaced, as applicable, in accordance with the Riparian Habitat Monitoring Management and Mitigation Plan, and will be coordinated with the USFWS and NMFS and/or other agencies as appropriate. If bank stabilization activities are necessary, then such stabilization will be constructed to minimize predator habitat, minimize erosion potential, minimize sedimentation in the waterway, and contain material suitable for supporting riparian vegetation.	NMFS

Acronyms:
BMP = best management practice
CNDDB = California Natural Diversity Database
Corps = U.S. Army Corps of Engineers
DFW = California Department of Fish and Wildlife
NMFS = National Marine Fisheries Service
PEIS/R = Program Environmental Impacts Statement/Report
Reclamation = U.S. Department of the Interior, Bureau of Reclamation
RWQCB = Regional Water Quality Control Board
SJRRP = San Joaquin River Restoration Program
State = State of California
USFWS = U.S. Fish and Wildlife Service

2.29 Minimize Flood Risk from Restoration Flows

The Program's strategy for minimizing flood risk is to limit the maximum downstream extent and rate of Restoration Flows for the given reach to then-existing channel capacities. This strategy is incorporated by reference from the PEIS/R (SJRRP 2011a, pages 2-22 through 2-28) and summarized here. These Program-wide commitments are documented in the PEIS/R Record of Decision (ROD). No new Project-level actions to minimize flood risk from Restoration Flows are being proposed.

Throughout Settlement implementation, the maximum downstream extent and rate of Restoration Flows to be released through a reach will be maintained at or below then-existing channel capacities. As channel or structure modifications are completed, maximum Restoration Flow releases will be correspondingly increased in accordance with then-existing channel capacities and with the release schedule. Consistent with the San Joaquin River Restoration Settlement Act, Interim Flows (2009-2014) were reduced, as needed, to address material seepage impacts, as identified through the monitoring program (see the Program's *Physical Monitoring and Management Plan* and *Seepage Management Plan* (PEIS/R Appendices D.1 and D.2, SJRRP 2011a)). If release of water from Friant Dam is required for flood control purposes, concurrent Restoration Flows will be reduced by an amount equivalent to the required flood control release. If flood control releases from Friant exceed the concurrent scheduled Restoration Flows, no additional releases above those required for flood control will be made for SJRRP purposes.

Then-existing channel capacities within the Restoration Area correspond to flows that would not significantly increase flood risk from Interim and Restoration flows in the Restoration Area (see the *Channel Capacity Report* (SJRRP 2015)). The action to release Restoration Flows includes measures that would achieve the following objectives: (1) commit Reclamation to implementing actions that would meet performance standards that minimize increases in flood risk as a result of Restoration Flows, (2) limit the release and conveyance of Restoration Flows to those flows that would remain in-channel until adequate data are available to apply the performance standards and until the performance standards are satisfied, and (3) enable the Settlement to be implemented in coordination with other ongoing and future actions outside of the Settlement that could address channel capacity issues identified in the Settlement or through the SJRRP or other programs. Implementation of measures that achieve these objectives will allow for the safe release and conveyance of Restoration Flows throughout the duration of Settlement implementation.

Reclamation will continue to implement the following three integrated measures that collectively minimize increases in flood risk as a result of Restoration Flows during Settlement implementation:

- **Establish a Channel Capacity Advisory Group and Determine and Update Estimates of Then-Existing Channel Capacities as Needed –** The establishment and administration of a Channel Capacity Advisory Group to provide independent review of estimated then-existing channel capacities, monitoring results, and management actions to address vegetation and sediment transport within the system as identified by Reclamation.
- **Maintain Restoration Flows at or Below Estimates of Then-Existing Channel Capacities –** The process for limiting Restoration Flows to reduce the risk of levee failure due to underseepage, through-seepage, and associated levee stability issues to less-than-significant levels.
- **Closely Monitor Erosion and Perform Maintenance and/or Reduce Restoration Flows as Necessary to Avoid Erosion-Related Impacts –** The commitment by Reclamation to implement erosion monitoring and management, including monitoring potential erosion sites, reducing Restoration Flows as necessary, and reporting ongoing results of monitoring and management actions to the Channel Capacity Advisory Group.

Only limited data are currently available on San Joaquin River channel capacities and levee conditions. The levee design criteria developed by the Corps and presented in *Design and Construction of Levees Engineering and Design Manual* (Manual No. 1110-2-1913) (Corps 2000a), *Slope Stability* (Manual No. 1110-2-1902) (Corps 2003), and *Design Guidance for Levee Underseepage* (Engineering Technical Letter No. 1110-2-569) (Corps 2005) will be applied throughout the Restoration Area to identify the Restoration Flows that would not cause the levee slope stability Factor of Safety to be reduced below 1.4, or the underseepage Factor of Safety to be reduced below the value corresponding to an exit gradient at the toe of the levee of 0.5. The levee slope stability Factor of Safety is defined as the ratio of available shear strength of the top stratum of the levee slope to the necessary shear strength to keep the slope stable (Corps 2003), and minimum levee slope stability factors of safety are given by the Corps levee criteria shown in Table 2-5. The application of the levee slope stability Factor of Safety of 1.4 is required for federally authorized flood control projects. Through-seepage is calculated as part of the slope stability analysis and does not have a separate Factor of Safety. The underseepage

Factor of Safety is defined as a ratio of the critical hydraulic gradient to the actual exit gradient of seepage on the levee. Corps design guidance recommends that the allowable underseepage factor of safety for use in evaluations and/or design of seepage control measures should correspond to an exit gradient at the toe of the levee of 0.5 (in general, this would provide a Factor of Safety of 1.6), but states that deviation from recommended design guidance is acceptable when based and documented on sound engineering judgment and experience (Corps 2005).

Until adequate data are available to determine the Factor of Safety, Reclamation would limit the release of Interim and Restoration flows to those which would remain in-channel. In-channel flows are flows that maintain a water surface elevation at or below the elevation of the landside levee toe (i.e., the base of the levee). When sufficient data are available to determine the Factor of Safety, Reclamation will limit Restoration Flows to levels that would correspond to a Factor of Safety of 1.4 or higher and an underseepage Factor of Safety corresponding to an exit gradient at the toe of the levee of 0.5 or lower at all times. Observation of levee erosion, seepage, boils, impaired emergency levee access, or other indications of increased flood risk identified through ongoing monitoring at potential erosion sites would indicate that the minimum Factor of Safety is not met and would trigger immediate reductions in Restoration Flows at the site. Such observations would supersede channel capacity estimates, and Restoration Flows will be reduced in areas where these conditions occur.

DWR has performed levee evaluations on Project levees in Reach 2A, Reach 3, the Middle Eastside Bypass, Mariposa Bypass, and Reach 4B2 of the San Joaquin River, and will be performing levee evaluations on the rest of Reaches 3 and 4A in the next two years. These levee evaluations are informing the channel capacity allowed in each annual Channel Capacity Report. Prior to construction of the Project, DWR will evaluate the downstream levees and compare the obtained geotechnical information with the levee failure points established in the redirected flood impacts Flood Damage Assessment modeling performed as part of the PEIS/R.

Table 2-5.
Minimum Factors of Safety - Levee Slope Stability

Type of Slope	Applicable Stability Conditions and Required Factors of Safety			
	End-of-Construction	Long-Term (Steady Seepage)	Rapid Drawdown[a]	Earthquake[b]
New Levees	1.3	1.4	1.0 to 1.2	(see below)
Existing Levees	--	1.4[c]	1.0 to 1.2	(see below)
Other Embankments and Dikes[d]	1.3[e,f]	1.4[c,f]	1.0 to 1.2[f]	(see below)

Source: U.S. Army Corps of Engineers 2000a. Design and Construction of Levees Engineering and Design Manual. Manual No. 1110-2-1913. April. Table 6-1b, page 6-5.

Notes:

[a] Sudden drawdown analyses. F. S. = 1.0 applies to pool levels prior to drawdown for conditions where these water levels are unlikely to persist for long periods preceding drawdown. F. S. = 1.2 applies to pool level, likely to persist for long periods prior to drawdown.

[b] See ER 1110-2-1806 for guidance. An EM for seismic stability analysis is under preparation.

[c] For existing slopes where either sliding or large deformation have occurred previously and back analyses have been performed to establish design shear strengths lower factors of safety may be used. In such cases probabilistic analyses may be useful in supporting the use of lower factors of safety for design.

[d] Includes slopes which are part of cofferdams, retention dikes, stockpiles, navigation channels, breakwater, river banks, and excavation slopes.

[e] Temporary excavated slopes are sometimes designed for only short-term stability with the knowledge that long-term stability is not adequate. In such cases higher factors of safety may be required for end-of-construction to ensure stability during the time the excavation is to remain open. Special care is required in design of temporary slopes, which do not have adequate stability for the long-term (steady seepage) condition.

[f] Lower factors of safety may be appropriate when the consequences of failure in terms of safety, environmental damage and economic losses are small.

2.30 Other Environmental Commitments

Environmental commitments are measures or practices adopted by a project proponent to reduce or avoid adverse effects that could otherwise result from project construction or operations. These measures include the mitigation measures identified in the EIS/R. The following section describes these additional environmental commitments that would be implemented with the Project to avoid potentially adverse environmental consequences. Many of these measures are consistent with those specified in the PEIS/R ROD.

Air Quality

- The Project proponents will comply with San Joaquin Valley Air Pollution Control District (SJVAPCD) Regulation VIII. Control measures will be implemented to reduce emissions of particulate matter (predominantly dust/dirt) generated by Project activities, including construction and demolition activities, road construction, bulk materials storage, paved and unpaved roads, carryout and track out, and landfill operations. Control measures include phasing work to reduce the amount of surface area disturbed at any one time, applying water to the construction site to limit visual dust emissions, limiting the speed vehicles travel on unpaved access/haul roads, storing and handling bulk materials in such a manner that minimizes visual dust emissions, minimizing carryout and trackout of soils from unpaved surfaces to paved surfaces, and preparing and implementing a Dust Control Plan.

- The Project proponents will implement Mitigation Measures AQ-1A, AQ-1B, AQ-1C, AQ-2, AQ-3A, and AQ-3B, as described in Chapter 4.0, "Air Quality." Implementation of these measures will reduce criteria exhaust emissions from construction equipment, reduce criteria exhaust emissions from material hauling vehicles, offset Project construction emissions through a SJVAPCD voluntary emission reduction agreement, reduce or offset Project emissions, reduce diesel particulate matter emissions from construction equipment, and reduce diesel particulate matter emissions from material hauling vehicles.

Biological Resources – Fisheries

- The Project proponents will require a NMFS-approved Worker Environmental Awareness Training Program for construction personnel to be conducted by the NMFS-approved biologist for all construction workers prior to the start of construction activities. The program will provide workers with information on their responsibilities with regard to Federally-listed fish, their critical habitat, an overview of the life-history of these species, information on take prohibitions, protections under the ESA, and an explanation of the applicable contract requirements or terms and conditions identified in a NMFS biological opinion. Written documentation of the training must be submitted to the Project proponents within 14 days of the completion of training. A video recording of the training may be used in place of a live training, as needed.
- The construction contractor will use a vibratory hammer, where feasible, to avoid acoustic impacts to Federal Endangered Species Act (ESA)-listed fish when pile driving. If an impact hammer is necessary, in order to assess and minimize the impacts of underwater noise on salmonids, a pile driving analysis, including an assessment of sound levels from Project activities, would be submitted to NMFS prior to the start of any pile driving activities. If an impact hammer is necessary, the contractor would consider the use a cushion block to attenuate hydroacoustics during in-water pile driving.
- The construction contractor will use turbidity curtains during in-water work activities, where feasible, to minimize the release of sediment that may be stirred up by the construction activities.
- Construction work will be conducted under the guidance of a stormwater pollution prevention plan as required by the Construction General Permit (Order No. 2009-0009-DWQ, as amended). As a part of the sampling and monitoring requirements of this permit, in-water turbidity sampling will be conducted by a qualified person to show that turbidity levels do not exceed the limits in the Construction General Permit.
- The Project proponents will require mulches used for hydroseeding in the future floodplain area to contain low concentrations of fertilizer, to the extent feasible. The contractor will use erosion and sediment control measures to minimize harmful runoff into the aquatic ecosystem.

Cultural Resources

- The Project proponents will implement Mitigation Measures CUL-1A, CUL-1B, CUL-1C, CUL-1D, and CUL-1E, as described in Chapter 9.0, "Cultural Resources." With implementation of these measures, the Project proponents will comply with Section 106 of the NHPA or equivalent, conduct subsurface testing and/or archaeological monitoring in

proximity to identified sites or areas of sensitivity, halt work in the event of an archaeological discovery, plan an intentional site burial preservation in place (where applicable), and avoid soil borrowing in the vicinity of known archaeological resources.

Geology and Soils

- Site-specific geotechnical exploration, testing, and analysis will be conducted prior to final design to allow for the characterization of site soils and appropriate design of proposed structures with respect to potentially corrosive soils or subsidence conditions.
- Project proponents will prepare and implement a stormwater pollution prevention plan that complies with applicable Federal regulations concerning construction activities. (This measure is the same as GRW-1A and SQW-1.)
- Excavation of borrow materials will be done in accordance with Reclamation design standards, and comply with provisions of the Clean Water Act Section 402 and the National Pollutant Discharge Elimination System Construction General Permit.

Hydrology – Groundwater

- The Project proponents will implement Mitigation Measures GRW-1A and GRW-1B, as described in Chapter 13.0, "Hydrology – Groundwater." With implementation of these measures, the Project proponents will prepare and implement a stormwater pollution prevention plan and a construction groundwater management plan.

Hydrology – Surface Water Resources and Water Quality

- The Project proponents will implement Mitigation Measures SWQ-1 and SWQ-3, as described in Chapter 14.0, "Hydrology – Surface Water Resources and Water Quality." With implementation of these measures, the Project proponents will develop and implement a stormwater pollution prevention plan and minimize the use of pesticide and herbicide contaminated soil.

Land Use Planning and Agricultural Resources

- The Project proponents will implement Mitigation Measures LU-1, LU-2, LU-3, and LU-5, as described in Chapter 16.0, "Land Use Planning and Agricultural Resources." With implementation of these measures, the Project proponents will preserve agricultural productivity of designated farmland to the extent possible, and notify county planning agencies of general plan and zoning ordinance inconsistencies.

Noise and Vibration

- The Project proponents will implement Mitigation Measures NOI-1 and NOI-3, as described in Chapter 17.0, "Noise and Vibration." Implementation of these measures will reduce temporary and short-term noise levels from construction-related equipment near sensitive receptors and reduce temporary noise levels from construction-related traffic increases near sensitive receptors.

Paleontological Resources

- The Project proponents will implement Mitigation Measures PAL-1, as described in Chapter 18.0, "Paleontological Resources." With implementation of these measures, the Project proponents will stop work if paleontological resources are encountered during earthmoving activities and implement a recovery plan.

Public Health and Hazardous Materials

- The Project proponents will comply with the California Environmental Protection Agency's (Cal/EPA's) Unified Program.
- The Project proponents will comply with Federal, State, and local hazardous materials regulations, as applicable, monitored by the State (e.g., California Occupational Safety and Health Administration [Cal/OSHA], Department of Toxic Substances Control, California Highway Patrol) and/or local jurisdictions.
- Project proponents will adopt reasonable wildland fire safety strategies and have the firefighting equipment required by Cal/OSHA during all phases of construction.
- The Project proponents will implement Mitigation Measures HAZ-2A, HAZ-2B, HAZ-2C, HAZ-2D, HAZ-2E, HAZ-3, HAZ-4, HAZ-5A, HAZ-5B, HAZ-5C, and HAZ-6, as described in Chapter 19.0, "Public Health and Hazardous Materials." With implementation of these measures, the Project proponents will follow general hazardous materials guidelines, properly dispose of hazardous building components, properly dispose of pesticides, properly manage discolored or odiferous soils, properly remove underground storage tanks, minimize disturbance to known hazardous material sites, minimize use of pesticide and herbicide contaminated soil, minimize exposure to potential West Nile Virus carrying vectors, minimize exposure to potential Hantavirus vectors, minimize exposure to Valley Fever, and minimize the disturbance of idle or abandoned wells.

Recreation

- The Project proponents will implement Mitigation Measures REC-1 and REC-2, as described in Chapter 20.0, "Recreation." With implementation of these measures, the Project proponents will minimize construction effects on recreation uses and establish boat portage facilities around Project facilities.

Transportation and Traffic

- The Project proponents will comply with Department of Motor Vehicles codes by requiring contractors and employees to be properly licensed and endorsed when operating commercial vehicles.
- The Project proponents will comply with California Vehicle Code section 35551 by enforcing compliance with weight restrictions on vehicles traveling on freeways and highways and by requiring heavy haulers to obtain permits, if required, prior to delivery of any heavy haul load.

- The Project proponents will comply with California Vehicle Code section 35780 by requiring heavy haulers to obtain a Single-Trip Transportation Permit prior to delivery of any oversized load.
- The Project proponents will coordinate with the California Department of Transportation (Caltrans) for relocation of any structures or fixtures necessary to telegraph, telephone, or electric power lines or of any ditches, pipes, drains, sewers, or underground structures located in the public rights-of-way.
- As required by the PEIS/R ROD, Project proponents will prepare and implement a traffic management plan that identifies the number of truck trips, time of day for arrival and departure of trucks, limits on number of truck trips, and traffic circulation control measures. Control measures typically include advertising planned lane closures, warning signage, a flag person to direct traffic flows when needed, and methods for maintaining continued access by emergency vehicles. During project construction, access to existing land uses will be maintained at all times, with detours used as necessary during road closures. The traffic management plan will be submitted to the appropriate county public works, fire, police, and sheriff departments for comments.
- The Project proponents will implement Mitigation Measure TRA-4B, as described in Chapter 22.0, "Transportation and Traffic." With implementation of this measure, the Project proponents will use construction sequencing to provide continuous emergency access at Drive 10 ½.

Utilities and Service Systems

- As required by the PEIS/R ROD to minimize and avoid disruption of subsurface utilities from ground-disturbing activities, Project proponents will (1) confirm the location of existing underground utilities, (2) coordinate with the owners of transmission lines and pipelines, (3) design restoration actions to avoid affecting underground facilities, if feasible, and (4) coordinate with the utility owner to shut off and relocate the utilities, as necessary.
- The location of public utilities will be confirmed and appropriate notifications will be made by contacting utility providers (e.g., power and communication utility service, and irrigation district service) who operate, maintain or own utilities in the Project area.
- Construction contractors will request an underground service alert from Underground Service Alert North in advance of earthmoving activities to locate and avoid underground utilities.
- Solid waste removed from the Project area will be disposed of in a permitted landfill. The operator of the recycling/disposal location will be notified and Project proponents will obtain approval for the type and amount of solid waste that will be generated.

Visual Resources

- The Project proponents will implement Mitigation Measures VIS-1 and VIS-6, as described in Chapter 24.0, "Visual Resources." With implementation of these measures, the Project proponents will minimize visual disruption from construction activities and conform to lighting standards, where applicable.

2.31 Permitting

Reclamation will obtain all necessary permits, as required by law. Implementation of the Project may require the permits and approvals described in Table 2-6. In general, Federal and State actions (permit issuance) will require a signed ROD (NEPA) and findings, EIR certification, and Notice of Determination (NOD) documents (CEQA). Additional information on permit acquisition procedures, submittal package requirements, critical issues, timing, and permit fees is discussed in the Project's Regulatory Compliance TM (SJRRP 2011b).

Table 2-6.
Summary of Permits and Approvals that May be Required for the Project

Agency and Associated Permit or Approval	Lead Agency for Submittal
Corps Clean Water Act Section 404 Individual Permit Rivers and Harbors Act Section 10 Permit	Reclamation
USFWS/ NMFS Endangered Species Act Section 7 Consultation Magnuson-Stevens Fisheries Conservation and Management Act Consultation	Reclamation
USFWS Fish and Wildlife Coordination Act Report	USFWS/NMFS
SHPO/ ACHP National Historic Preservation Act, Section 106 Programmatic Agreement	Reclamation
Central Valley RWQCB Clean Water Act Section 401 Water Quality Certification	Reclamation
SWRCB/ Central Valley RWQCB Clean Water Act Section 402 Construction General Permit	Reclamation
SWRCB Amended water rights	Reclamation
CSLC Land Use Lease	Reclamation
SJVAPCD Air Impact Analysis Regulation VIII Dust Control Plan Federal Clean Air Act	Reclamation
Fresno/Madera Counties Williamson Act Contracts Land Use/Zoning	Reclamation

Key:

ACHP = Advisory Council on Historic Preservation
Central Valley RWQCB = Central Valley Regional Water Quality Control Board
Corps = U.S. Army Corps of Engineers
CSLC = California State Lands Commission
NMFS = National Marine Fisheries Service
Reclamation = U.S. Department of the Interior, Bureau of Reclamation
SHPO = State Historic Preservation Officer
SJVAPCD = San Joaquin Valley Air Pollution Control District
SWRCB = State Water Resources Control Board
USFWS = U.S. Fish and Wildlife Service

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