Mendota Pool Bypass and Reach 2B Improvements Project

Initial Options Technical Memorandum

SAN JOAQUIN RIVER
RESTORATION PROGRAM

April 2010

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List of Abbreviations and Acronyms

° C	degrees centigrade
Act	San Joaquin River Restoration Settlement Act
Cal/EPA	California Environmental Protection Agency
CEQ	Council on Environmental Quality
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
Court	U.S. Eastern District Court of California
CVFPB	Central Valley Flood Protection Board
CVP	Central Valley Project
Delta	Sacramento-San Joaquin Delta
DFG	California Department of Fish and Game
DWR	California Department of Water Resources
EA	Environmental Assessment
EIS/R	Environmental Impact Statement/Environmental Impact Report
ESA	Endangered Species Act
FMWG	SJRRP Fisheries Management Work Group
FONSI	Finding of No Significant Impact
Flood Control Project	Lower San Joaquin River Flood Control Project
Flood Operation Manual	Flood Control Project’s Operation and Maintenance Manual for Levee, Irrigation and Drainage Structures, Channels and Miscellaneous Facilities
fps	feet per second
FWCA	Fish and Wildlife Coordination Act
FWUA	Friant Water Users Authority
IS	Initial Study
Levee District	Lower San Joaquin Levee District
m^2	square meters
MMRP	Mitigation Monitoring and Reporting Program
MND	Mitigated Negative Declaration
MPB	Mendota Pool Bypass
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service

NRDC	Natural Resources Defense Council
OHV	off-highway vehicle
PEIS/R	Program Environmental Impact Statement/ Environmental Impact Report
Pool	Mendota Pool
PRC	Public Resources Code
Project	Mendota Pool Bypass and Reach 2B Improvements Project
Reclamation	U.S. Department of the Interior, Bureau of Reclamation
Restoration Area	the San Joaquin River Restoration area from Friant Dam to the Merced River confluence
RWA	Recovered Water Account
Secretary	Secretary of the U.S. Department of the Interior
Settlement	Stipulation of Settlement
SJRRP	San Joaquin River Restoration Program
SRAC	Sacramento River Advisory Council
State	State of California
SWP	State Water Project
SWRCB	State Water Resources Control Board
TM	Technical Memorandum
USACE	U.S. Army Corps of Engineers
USC	United States Code
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service

Definitions

Pre-appraisal level themes – Pre-appraisal level themes are concepts used in an iterative process of modeling coupled with public outreach and concept refinement. Themes were refined during the preparation of this Technical Memorandum (TM), and the refined themes are presented here as initial options.

Initial Options – Initial options represent building blocks for future development of project alternatives. Initial options have been prepared for each project component and presented as a “menu” of preliminary ideas to meet the project goals for each component. The initial options presented here would be further refined by subsequent data collection, analysis and analytical tools. Under a future phase of alternative development, the options would be developed into alternatives based on a set of evaluation criteria developed pursuant to National Environmental Policy Act (NEPA) and California Environmental Quality Act (CEQA), and in coordination with the U.S. Department of the Interior, Bureau of Reclamation (Reclamation).

Alternatives – The project alternatives that would be presented in the Environmental Impact Statement/Environmental Impact Report (EIS/R). Alternatives are of a sufficient detail to evaluate benefits and impacts, including project costs, land acquisition, and mitigation needs. Each alternative for this project would include actions for both the Mendota Pool Bypass and the Reach 2B improvements.

This Draft Technical Memorandum (TM) was prepared by the San Joaquin River Restoration Program (SJRRP) Team as a draft document in support of preparing an Environmental Impact Statement/Environmental Impact Report (EIS/R) for the Mendota Pool Bypass and Reach 2B Improvements Project (Project). The purpose for circulating this document at this time is to facilitate early coordination regarding initial approaches currently under consideration by the SJRRP Team with the Settling Parties, Third Parties, other stakeholders, and interested members of the public. Therefore, the content of this document may not necessarily be included in the Project EIS/R. While the SJRRP Team is not requesting formal comments on this document, all comments received will be considered in refining the concepts and approaches described herein to the extent possible.

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1.0 Introduction

This Initial Options Technical Memorandum (TM) documents the process for formulating preliminary options to implement the Mendota Pool Bypass and Reach 2B Improvements Project (Project), a component of Phase 1 of the overall San Joaquin River Restoration Program (SJRRP). The SJRRP was established in late 2006 to implement the Stipulation of Settlement (Settlement) in *NRDC, et al,. v. Kirk Rodgers, et al*.

The U.S. Department of the Interior, Bureau of Reclamation (Reclamation), as the Federal lead agency under the National Environmental Policy Act (NEPA), and the California Department of Water Resources (DWR), as the State lead agency under the California Environmental Quality Act (CEQA), prepared this TM as an initial step in preparation of an Environmental Impact Statement/ Environmental Impact Report (EIS/R) for the Project, which is a requirement under the Settlement. Federal authorization for implementing the Settlement is provided in the San Joaquin River Restoration Settlement Act (Act) (Public Law 111-11).

1.1 Purpose of this TM

This TM is intended to:

- Document the alternatives formulation process for the Project
- Summarize the purpose and need of the Project and define the objectives, opportunities, and constraints associated with project implementation
- Establish the No-Action/No-Project Alternative
- Examine a wide range of approaches that could meet the Settlement goals for the Project
- Obtain input and feedback from the Implementing Agencies, Technical Work Groups, landowners, and other stakeholders involved in the Project to help refine the initial options into alternatives
- Establish a process for developing and analyzing the alternatives as part of the NEPA and CEQA documentation for the Project

1.2 Background

1.2.1 Pre-Settlement Historical Context

Originating high in the Sierra Nevada Mountains, the San Joaquin River carries snowmelt from mountain meadows to the valley floor before turning north and becoming the backbone of tributaries draining into the San Joaquin Valley. The San Joaquin River is

California's second longest river and discharges to the Sacramento-San Joaquin Delta (Delta) and, ultimately, to the Pacific Ocean through San Francisco Bay.

Historically, the San Joaquin River supported a rich and diverse ecosystem influenced by seasonal runoff patterns. During winter and spring months, runoff from Sierra Nevada streams would spread over the valley floor and slowly drain to the Delta, providing rich habitat supporting numerous aquatic and wildlife species, including Chinook salmon.

Over the past two centuries, development of water resources transformed the San Joaquin River. In the late 1880s, settlers in the Central Valley drained large areas of valley floor lands and put these lands into agricultural production, supported by small and seasonal diversion dams on the river and a series of water conveyance and drainage canals. Hydroelectric project development in the upper portions of the San Joaquin River watershed harnessed power from the river and modified the natural flow patterns.

In 1944, Reclamation completed construction of Friant Dam on the San Joaquin River. With the completion of Friant-Kern Canal in 1951 and Madera Canal in 1945, Friant Dam diverted San Joaquin River water supplies to over 1 million acres of highly productive farmland along the eastern portion of the San Joaquin Valley. Operation of the dam ceased flow in some portions of the river and extirpated salmon runs in the San Joaquin River upstream from the confluence with the Merced River.

1.2.2 Stipulation of Settlement

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 (CVP) Friant Division contractors. On September 13, 2006, after more than 18 years of litigation, the Settling Parties, including NRDC, Friant Water Users Authority (FWUA), and the U.S. Departments of the Interior and Commerce, agreed on the terms and conditions of a Settlement subsequently approved by the U.S. Eastern District Court of California (Court) on October 23, 2006. The San Joaquin River Restoration Settlement Act (Act), included in Public Law 111-11 and signed into law on March 30, 2009, authorizes and directs the Secretary of the Interior (Secretary) to implement the 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

To achieve the Restoration Goal, the Settlement calls for releases of water from Friant Dam to the confluence of the Merced River (referred to as Interim and Restoration flows), a combination of channel and structural modifications along the San Joaquin River below Friant Dam, 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 for the purpose of reducing or avoiding impacts to water deliveries to all of the Friant Division long-term contractors caused by the Interim and Restoration flows. In addition, the Settlement establishes a Recovered Water Account and program to make water available to all of the Friant Division long-term contractors who provide water to meet Interim or Restoration flows for the purpose of reducing or avoiding the impact of the Interim and Restoration flows on such contractors. Restoration Flows are specific volumes of water to be released from Friant Dam during different year types according to Exhibit B of the Settlement; Interim Flows began in 2009 and would continue until full Restoration Flows are initiated, with the purpose of collecting relevant data concerning flows, temperatures, fish needs, seepage losses, recirculation, recapture, and reuse.

The Settlement and the Act authorize and direct specific physical and operational actions that could potentially directly or indirectly affect environmental conditions in the Central Valley. Areas potentially affected by Settlement actions include the San Joaquin River and associated flood bypass system, tributaries to the San Joaquin River, the Delta, and water service areas of the CVP and State Water Project (SWP), including the Friant Division. Settlement Paragraphs 11 through 16 describe physical and operational actions (see Table 1-1).

Table 1-1
Restoration and Water Management Framework in Key Settlement Paragraphs

Settlement Paragraph	Description of Constraint or Assumption
11	Identifies specific channel and structural improvements considered necessary to achieve the Restoration Goal. Includes a reach-by-reach list of improvements.
12	Acknowledges that additional channel or structural improvements not identified in Paragraph 11 may be needed to achieve the Restoration Goal.
13	Identifies specific volumes of water to be released from Friant Dam during different year-types (Critical-Low to Wet, as specified in flow schedules provided in Exhibit B of the Settlement), and provisional water supplies to meet the Restoration Flow targets as provided in Exhibit B of the Settlement.
14	Stipulates that spring-run and fall-run Chinook salmon be reintroduced to the San Joaquin River between Friant Dam and the confluence of the San Joaquin River with the Merced River no later than December 31, 2012. Assigns priority to wild spring-run Chinook salmon over fall-run Chinook salmon.
15	Specifies that Interim Flows begin no later than October 1, 2009, and continue until full Restoration Flows can begin.
16	Requires that the Secretary of the Interior develop and implement a plan for recirculation, recapture, reuse, exchange, or transfer of the Interim and Restoration flows to reduce or avoid impacts to water deliveries for all Friant Division long-term contractors. This paragraph also calls for establishment of an RWA and program to make water available to the Friant Division long-term contractors who provide water to meet Interim or Restoration flows.

Key:
CEQA = California Environmental Quality Act
NEPA = National Environmental Policy Act
PEIS/R = Program Environmental Impact Statement/Environmental Impact Report
RWA = Recovered Water Account

1.2.3 San Joaquin River Restoration Program

The SJRRP comprises several Federal and State of California (State) agencies responsible for implementing the Settlement. Implementing Agencies include the U.S. Department of the Interior, Bureau of Reclamation, U.S. Fish and Wildlife Service, National Marine Fisheries Service, California Department of Water Resources, and California Department of Fish and Game.

1.2.4 Overview of the Mendota Pool Bypass and Reach 2B Improvements

The Mendota Pool Bypass and Reach 2B Improvements Project (Project) includes the construction, operation, and maintenance of the Mendota Pool Bypass and improvements in the San Joaquin River channel in Reach 2B to convey at least 4,500 cubic feet per second (cfs). The Project area (Figure 1-1) extends from the Chowchilla Bypass Bifurcation Structure to approximately 1 mile below the Mendota Dam. The extent of Project area boundaries will depend on the final alternatives considered. The Project area is in Fresno and Madera counties, near the town of Mendota.

Paragraph 11(a)(1) of the Settlement stipulates the creation of a bypass channel around the Pool to ensure conveyance of at least 4,500 cfs from Reach 2B downstream to Reach 3. Paragraph 11(a)(2) of the Settlement stipulates modifications in channel capacity, incorporating new floodplain habitat and related riparian habitat, to ensure conveyance of at least 4,500 cfs between the Chowchilla Bypass Bifurcation Structure and the new Mendota Pool Bypass. Because the functions of these channels may be inter-related, the design, environmental compliance, and construction of the two are being addressed as one project. The Project shall be implemented consistent with the Settlement and the San Joaquin River Restoration Act, Public Law 111-11.

The Mendota Pool Bypass would include bypassing the Pool to convey at least 4,500 cfs from Reach 2B to Reach 3, and a method to direct upmigrating adult salmon into the bypass channel. This action would include the ability to divert 2,500 cfs to the Pool and may consist of a bifurcation structure in Reach 2B. The bifurcation structure would be designed to direct fish into the bypass channel and minimize or avoid fish entrainment to the Pool. This site-specific study will help determine specific bypass alignments and facilities locations.

Improvements to Reach 2B would include modifications to the San Joaquin River channel from the Chowchilla Bypass Bifurcation Structure to the new Mendota Bypass Bifurcation Structure to provide a capacity of at least 4,500 cfs with integrated floodplain habitat. The options to consider include potential levee set backs along Reach 2B to increase the channel floodplain capacity and provide for floodplain habitat. Floodplain habitat is included because Central Valley floodplains have been shown to be of value to rearing juvenile salmon as they migrate downstream (Jeffres et al. 2008, Grosholz and Gallo 2006, Sommer et al. 2004, Sommer et. al 2001)

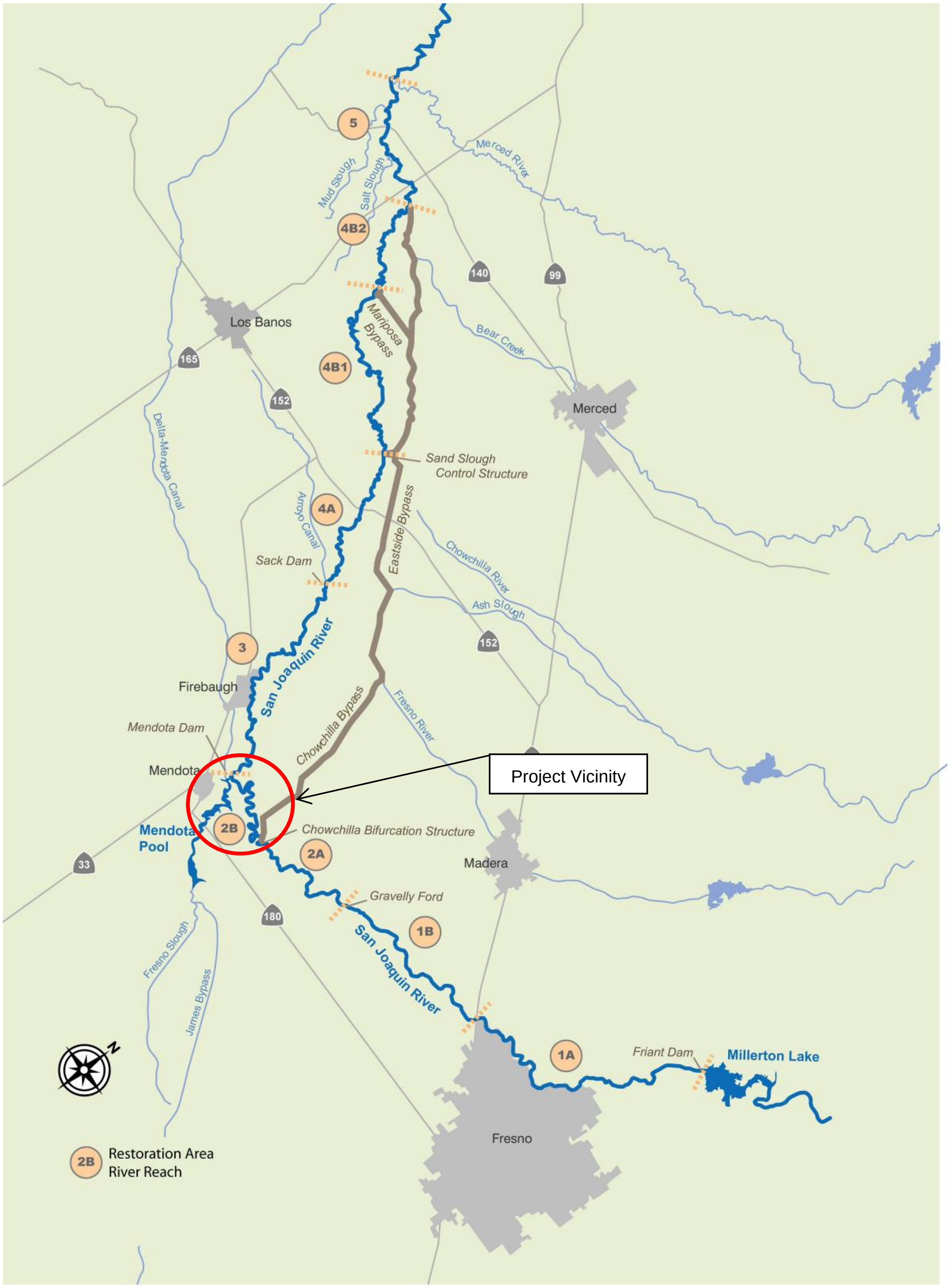

Figure 1-1
Overview of the SJRRP Restoration Area and the Project Vicinity

1.2.5 Overview of the Fishery Needs

The Settlement Agreement Paragraph 14 addresses restoration of salmon to the San Joaquin River. Extensive background information has been compiled to support this effort (McBain and Trush 2002, Stillwater 2003) and the Fisheries Management Work Group has developed a Draft Fisheries Management Plan (SJRRP 2009). The information compiled to date addresses Restoration Flows, fish passage, water temperatures, and physical channel habitat, including floodplains. Reach 2B needs to provide upstream migration habitat for adult salmon, including holding or refuge habitat and downstream migration habitat for juvenile salmon including feeding and holding habitat to support rearing of downstream migrants (transient rearing), including habitat on the floodplains when inundated. To successfully implement the Settlement requirement, reach improvements need to address the following life history stages and timing in Reach 2B. This discussion is condensed from the Restoration Objectives for the San Joaquin River (Stillwater Sciences 2003).

Adult Upstream Migration

Historically San Joaquin fall-run Chinook salmon typically migrated upstream beginning in September (Figure 1-2), with most adults migrating upstream in October through December (CDFG 1958). Currently, adult fall-run salmon in the San Joaquin River basin typically migrate upstream between October and early December. Historically, spring-run salmon on the San Joaquin River migrated upstream between April and early July, with most adults migrating upstream in May and June (Hallock and Von Woert 1959). Currently, the San Joaquin River basin has no population of spring-run salmon. However, spring-run populations in the Sacramento River basin typically migrate upstream between February and June (Stillwater Sciences 2003). All salmon runs, including fall-run Chinook in the San Joaquin upstream of the Merced River were extirpated by the late 1940s (Yoshiyama et al. 2001).

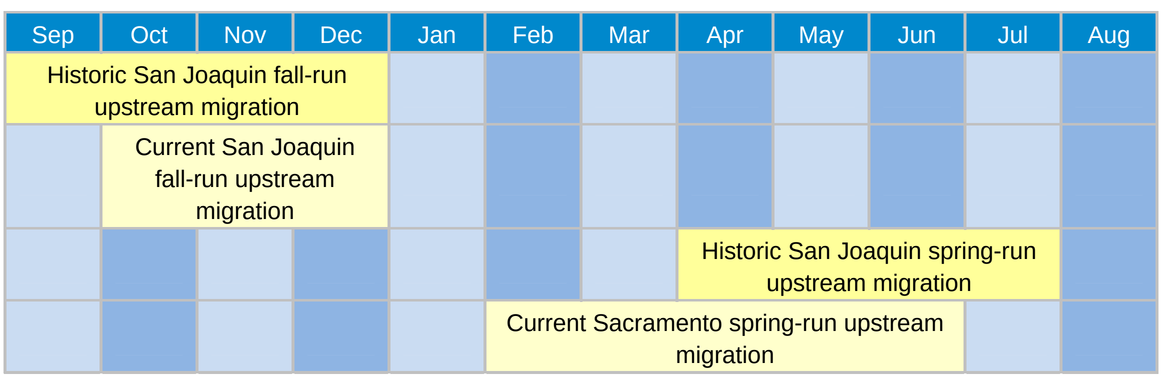

Figure 1-2
Historic and Current Upstream Migration Periods

Juvenile Rearing

The length of time spent rearing in freshwater varies for both fall and spring-run Chinook salmon juveniles. Fall-run Chinook salmon typically rear in freshwater for 1 to 3 months before outmigrating to the ocean, but some may disperse downstream as fry soon after emerging from the gravel. These young-of-the-year fish will occur in Reach 2B as transient fry or larger juveniles as they migrate downstream toward the ocean. Spring-run Chinook may migrate downstream as fingerlings early in their first summer; or they may move downstream in the fall as flows increase; or they may overwinter in freshwater and emigrate the following year as yearlings (Healey 1991). During winter and spring high flow events, rearing of fall and spring-run juveniles can occur on inundated floodplains. Spring or fall-run juveniles that stay in the river over summer to rear would likely take advantage of instream pools and runs in the main stem channel in Reach 1, but habitat conditions (temperature and flows) would not support year-round rearing in Reach 2B.

Juvenile Outmigration

Spring-run Chinook salmon

Outmigration trapping (fyke nets) in the San Joaquin River occurred at Mendota (1944-49) showed that the majority of fish passed Mendota between January and early June (Hallock and Von Woert 1959) (Figure 1-3). In 1944 the migration was high from late January to March and peaked in mid-February. The authors note that the seaward migration of juvenile salmon in the San Joaquin River system occurs during the period of major seasonal runoff but that there were considerable changes to the fish migration on the San Joaquin River from Friant Dam. At Mossdale in 1939 and 1940 the salmon fingerling outmigration occurred from January to mid-June with a peak in February and March. In the late 1940s there was a shift in timing of the peak migration in the San Joaquin River from January-March to March-mid-May with the peak occurring in April, which was attributed to the loss of spring-run in the San Joaquin and a dominance of fall run juveniles following closure of Friant Dam (Hallock and Von Woert 1959, and Hatton and Clark (1942) as cited in Williams 2006)

Fall-run Chinook salmon

In general, the bulk of fall-run Chinook salmon fry emigrate from spawning areas between January and May. Fall-run emigrating from the San Joaquin River are presently produced in the tributaries of the Stanislaus, Tuoloumne and Merced Rivers.

Central Valley Steelhead

Very little data is available on Central Valley steelhead in the San Joaquin River. Recent trapping on the Stanislaus River between December and July collect a few steelhead every month with fry collected during the spring and smolt-sized or older fish collected throughout the sampling period. (Williams 2006).

Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
				Current San Joaquin fall-run outmigration							
				Historic San Joaquin spring-run outmigration							

Figure 1-3
Historic and Current Outmigration Periods

1.3 Areas Potentially Affected

The study area for the Project, shown in Figure 1-4, (township 13S, range 15E) includes areas that may be affected directly or indirectly by implementing project actions. The Project has two major components: Reach 2B and the Mendota Pool Bypass. Reach 2B includes the area from the Chowchilla Bifurcation Structure downstream to Mendota Dam. Improvements in Reach 2B, at a minimum, extend from the Chowchilla Bifurcation Structure on the upstream end to the head of the Mendota Pool Bypass channel on the downstream end. However, Reach 2B improvements may also include areas just upstream of the Chowchilla Bifurcation Structure and may continue downstream of the head of the Mendota Pool Bypass, including the Pool area, as necessary to meet project goals and objectives. The Mendota Pool Bypass has multiple proposed alignment options. In the longest alignment currently under consideration (approximately 1.9 miles long), the Mendota Pool Bypass starts in Reach 2B approximately 2.8 river miles upstream of Mendota Dam and connects with Reach 3 approximately 1.5 river miles downstream of Mendota Dam. Areas indirectly affected include Reach 3 to the downstream and Reach 2A to the upstream.

At the initial options level of detail, the study area reflects current estimates. Development of project alternatives will refine the study area. At the alternatives level of detail, the area where direct and indirect effects may occur differs according to resource area; therefore, the geographic range that would be described in the Project EIS/R would vary by resource.

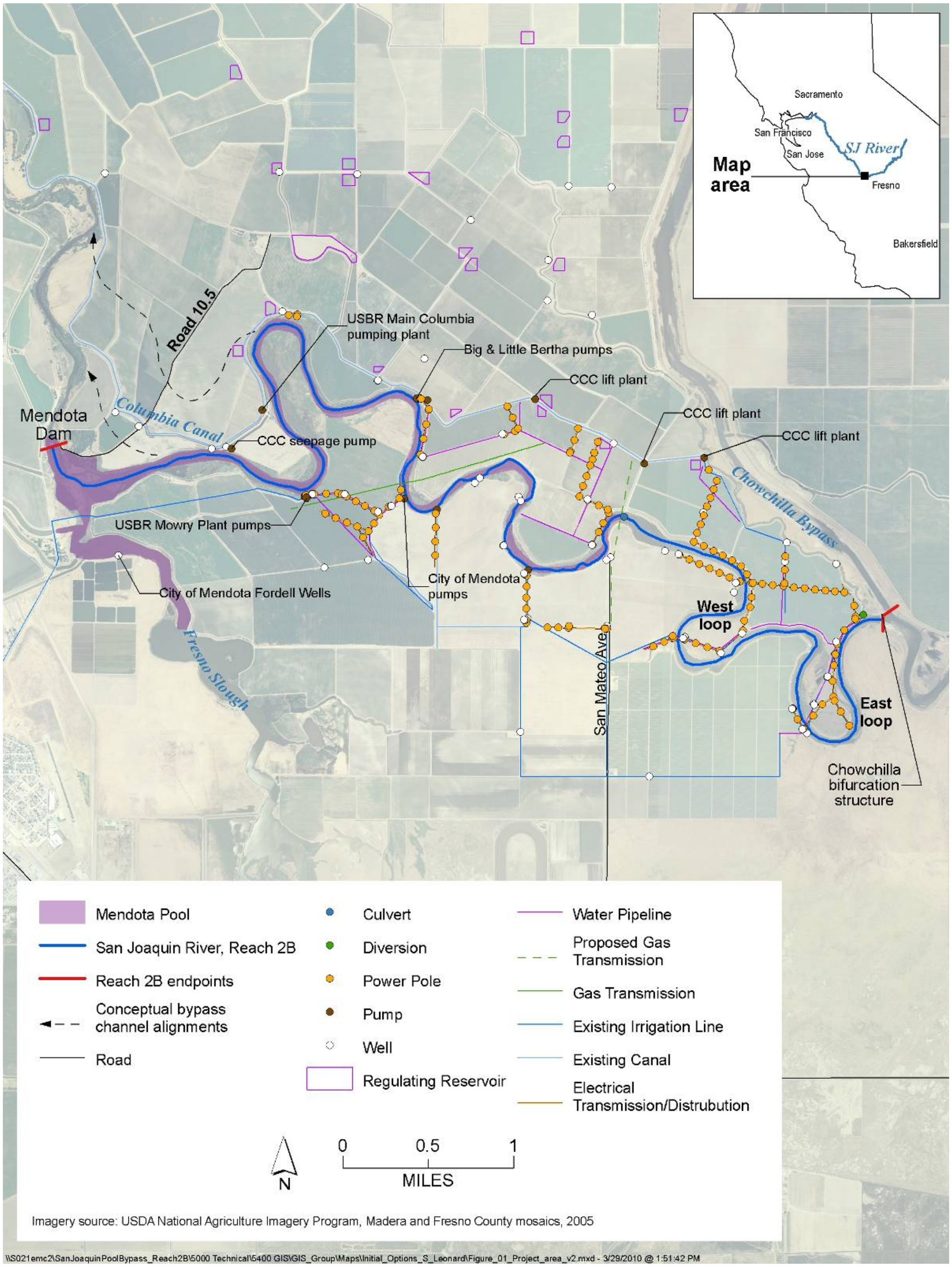

Figure 1-4
Mendota Pool Bypass and Reach 2B Channel Improvements Project Area

1.4 Description of Conditions within the Study Area

The Project begins on the upstream end at the Chowchilla Bifurcation Structure. The Chowchilla Bifurcation Structure is used to control flood flow into Reach 2B and to route flood releases from Friant Dam and the upstream watershed into the Chowchilla Bypass, a flood protection project on the San Joaquin River. Under no-flow conditions, plunge pools (approximately 7 feet deep and 10 feet deep, respectively) can be observed at the downstream base of the Chowchilla Bifurcation Structure in both the San Joaquin River and the Chowchilla Bypass.

Reach 2B ends on the downstream end at the Mendota Dam, which creates Mendota Pool (Pool). The Delta Mendota Canal terminates at the Pool, which distributes water deliveries from the Delta to the San Joaquin River Exchange Contractors (Exchange Contractors) via several canals. The Pool is shallow with little storage volume, and the pool elevation is maintained for the purposes of hydraulic head into Fresno Slough. The Pool does not contain additional storage above the operating elevation and, therefore, does not provide substantial flood control protection. During flood releases, the boards are removed at Mendota Dam allowing the backwatered Pool to become part of the flowing river.

The Project study area includes only one existing crossing, a dip-crossing at San Mateo Avenue, consisting of a culvert to convey low flows and an earthen embankment supporting the roadbed, which is overtopped during higher flows.

The San Mateo Avenue crossing is the approximate limits of the backwater effects of the Pool. Downstream of San Mateo Avenue, the river channel is inundated as a result of the Pool water surface elevation. Upstream of the crossing, the channel is dry except during flood releases from Friant Dam. The Pool and associated river channel is drained approximately every two years for inspection and maintenance purposes. The Pool backwater supports perennial riparian vegetation, predominantly willow riparian and cottonwood riparian forest communities with emergent wetland communities. In the dry portions of the reach upstream of San Mateo Avenue, the channel exhibits a dry sandy substrate with little to no in-channel vegetation. Existing vegetation along the banks of the channel in these areas consists predominantly of riparian scrub and willow scrub communities.

Portions of the existing river corridor in Reach 2B are privately owned. Land use surrounding the project area is primarily agriculture with the minor exception of the water management facilities at the Pool. Several water diversions (including Lone Willow Slough and the Columbia Canal), canals, lift stations, and groundwater wells exist within the Project area. Additionally, electrical and gas distribution lines and water pipelines lie within the Project area.

1.4.1 Existing Fish Population and Habitat Conditions

With the exception of the Pool and associated backwater, Reach 2B is dry except during flood flows (approximate frequency is every 3 years) and consequently there are very limited in-channel habitat features. The Pool contains mostly introduced fishes and potentially a few native fish. The biannual dewatering the pool leaves the Pool site mostly dry but some locations hold standing water during the several week period the pool is drained in mid-winter.

Figure 1-5
Existing Reach 2B Channel

The Reach 2B channel is entirely composed of unconsolidated fine sand and there appears to be little definition of the channel bed (Figure 1-5). No pool-bar structures or bed features occur that could be used to classify and evaluate typical fish habitat features (pools, riffles, runs) or conditions (instream cover, overhead cover, etc.).

Aquatic habitat in Reach 2B upstream of San Mateo Avenue is non-existent because there has been no sustained flow in the channel. Riparian vegetation is limited to the levees along the channel. The channel bed is generally devoid of a defined channel or aquatic habitat features such as pools and bars. In the lower portion of Reach 2B, the channel is defined where vegetation has been established along the backwatered portion from the Pool between Mendota Dam and San Mateo Avenue. The Pool is bordered by emergent, wetland and riparian vegetation including mature cottonwood trees. Aquatic habitat in this section of river is affected by the backwatering of Mendota Dam and sedimentation in the Pool.

1.4.2 Existing Structures

Chowchilla Bifurcation Structure

The most upstream structure is the Chowchilla Bifurcation Structure (Figure 1-6). This structure is used to route flood flows in excess of water supply demands down the Chowchilla Bypass. The structure has wingwalls bounding four gated bays on each channel. The bays are essentially 20-foot wide by 18-foot high box culverts containing a trash rack at the upstream end (Figure 1-7). The four bays discharge across a row of energy dissipaters (dragons teeth) then over a concrete slab that is bounded on the downstream end by a 2-foot

Figure 1-6
View from downstream of the Chowchilla Bifurcation Structure in Reach 2B

high concrete weir. Immediately below the concrete weir is a row of rip rap sitting against the concrete weir and above the sand bed of Reach 2B (Figure 1-8). Upstream and downstream of the structure, is the sand bed of Reach 2A and 2B, respectively.

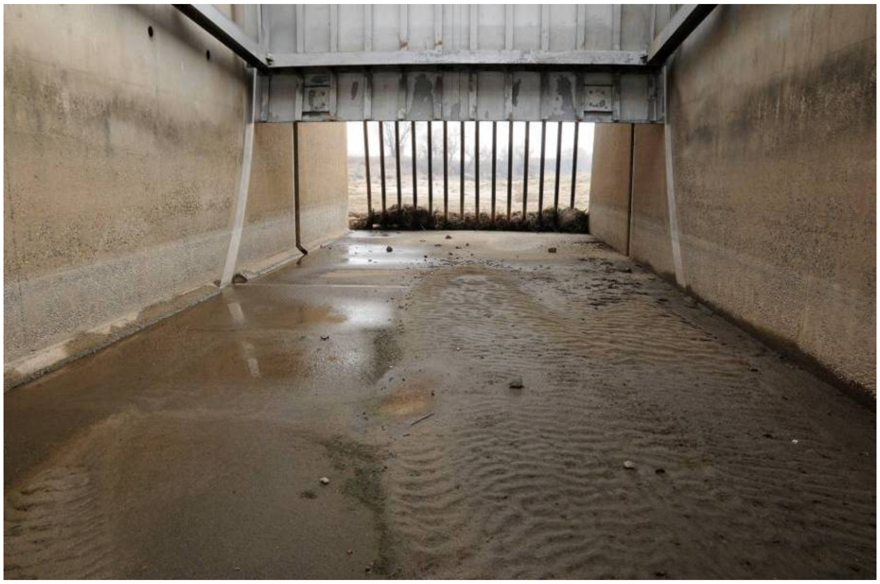

Figure 1-7
Inside of one of the bays at the Chowchilla Bifurcation Structure[1]

Figure 1-8
The concrete weir and bordering rip rap along the downstream edge of the Chowchilla Bifurcation Structure in Reach 2B

[1] Ponded water shown in Figure 1-7 and Figure 1-8 is the remains of the 2009 fall Interim Flows.

San Mateo Avenue Crossing

The present crossing of Reach 2B is a dip crossing or a low-water crossing (Figure 1-9). The road enters the river channel and the river is routed through a culvert beneath the road at flows less than approximately 150 cfs. At flows above approximately 150 cfs, the road is inundated (Houk 2009b) (Figure 1-10).

Figure 1-9
San Mateo Avenue Crossing of Reach 2B looking from north bank to south bank

Figure 1-10
San Mateo Avenue crossing of Reach 2B showing single culvert beneath the road

Mendota Dam and Mendota Pool

Mendota Dam (Figure 1-11), at the downstream end of Reach 2B, forms a pool to approximately 7 miles long to San Mateo Avenue. The downstream 2 to 3 miles of the channel is bordered by mature trees along the north bank. Typically, the Pool receives water from the Delta Mendota Canal which supplies water to the Helm Ditch, Main

Canal, Outside Canal, Main Lift Canal, Fresno Slough, and Columbia Canal. The Pool is shallow and is drained about every two years for dam inspection and maintenance.

Figure 1-11
Downstream face of Mendota Dam

1.5 Organization of this Technical Memorandum

The content and format of this TM are intended to dovetail with the future Project EIS/R, which will meet the requirements of NEPA, as set forth by the Council on Environmental Quality (CEQ) and Reclamation's NEPA policy and guidance, including the U.S Department of the Interior Implementation of NEPA and Final Rule, and CEQA and the State of California's CEQA Guidelines. The TM is organized as shown below.

Section 1.0 Introduction – summarizes project background and context, scope of this TM, project study area, and TM organization.

Section 2.0 Project Purpose and Need – describes the project purpose/project objectives and the need for action for the project.

Section 3.0 Goals and Objectives – presents the project goals and objectives organized according to the overarching project purposes.

Section 4.0 Opportunities and Constraints – provides an analysis of opportunities that exist outside the Project purpose and need and constraints within the study area.

Section 5.0 No-Action Alternative – provides a description of the no-action alternative/no-project alternative.

Section 6.0 Alternatives Formulation Process – summarizes the process that would be implemented for developing, evaluating, and selecting the project alternatives.

Section 7.0 Initial Project Options – describes the initial project options for each component of the project.

Section 8.0 Summary and Next Steps – describes the next steps in the development of the project environmental documentation.

Section 9.0 Acknowledgments – provides a list of those who contributed to the document.

Section 10.0 References – provides a bibliography of sources cited throughout this TM.

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2.0 Project Purpose and Need

NEPA regulations require a statement of "the underlying purpose and need to which the agency is responding in proposing the alternatives, including the Proposed Action" (40 CFR 1502.13). The State of California (State) CEQA Guidelines require a clearly written statement of objectives, including the underlying purpose of a project (Guidelines Section 15124(b)).

The purpose of the Proposed Action is to implement the Settlement of *NRDC, et al., v. Kirk Rodgers, et al.*, approved by the Court in October 2006 and authorized by Public Law 111-11, the San Joaquin River Restoration Settlement Act (Act). Specifically, this project addresses Paragraphs 11(a)(1) and 11(a)(2) of the Settlement, which are authorized in Sec. 10004.(a)(1) of the Act.

Paragraph 11(a)(1)

> *Creation of a bypass channel around Mendota Pool to ensure conveyance of at least 4,500 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;*

Paragraph 11(a)(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;*

The purpose responds to a need to increase water releases from Friant Dam to support achieving the Restoration Goal, as defined by the Settlement.

2.1 Problems

The *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* (Water Resources Council 1983) sets forth Federal objectives for water resources project planning which states that "[w]ater and related land resources project plans shall be formulated to alleviate problems". This section identifies the problems that should be alleviated by the Project.

The Settlement requires the Implementing Agencies to "restore and maintain fish populations in 'good condition'", which requires ensuring fish passage and conveyance of flows through Reach 2B and the Mendota Pool Bypass as well as supporting a naturally-reproducing, self-sustaining salmon population.

In order to successfully implement the Settlement requirements, reach improvements need to address the following specific concerns or problems.

1. San Joaquin River – Over the past 40 years, the upper portion of Reach 2B, between the Chowchilla Bifurcation Structure and San Mateo Avenue, received flow only during flood releases (approximately every three years on average). The lower portion of Reach 2B, between San Mateo Avenue and Mendota Dam, is inundated for the majority of the year by the Pool. The upper portion of the reach exhibits a loose sandy substrate with minimal vegetation. Capacity through the reach is designed to 2,500 cfs for the purposes of water deliveries to Mendota Pool, but current conditions in the channel restrict capacity to approximately 1,300 cfs.

2. Chowchilla Bifurcation Structure – This structure serves to control flows into Reach 2B and the Chowchilla Bypass. The structure may be an impediment to fish migration due to the riprap on the downstream side and the concrete weir (2 feet high) and baffle blocks within the structure.

    - Upstream Migrating Adults: During low flow conditions upstream passage through the Chowchilla Bifurcation Structure for adults could be impaired or prevented. The structure has four flat bottomed gated bays that discharge over a concrete weir onto rip rap before reaching the sand bed of the channel. Depending on backwater conditions at the base of the structure, upstream-migrating adults may be unable to access the bottom of the structure since no jump pool lies immediately below the concrete weir (Figure 1-6 and Figure 1-8). Upstream of the weir, the depth of flow through the bays is controlled by the weir elevation so there would be sufficient depth of flow to swim out of the structure (Figure 1-7). Accumulated debris on the trash racks at the upstream end of the structure could impair passage out of the structure under certain conditions.
    - Downstream Migrating Juveniles: During low flow conditions downstream passage through the Chowchilla Bifurcation Structure for juveniles could be impaired or prevented. For the same reason that adult fish have problems moving upstream over the weir, juvenile fish may have difficulty moving over the existing weir crest in a downstream direction when depth of flow over the weir is low. If they did pass over the weir, they may become stranded in the rock rip rap at the base of the weir wall when flows are insufficient to provide surface flow connections between the weir spill and the downstream river.
    - Juvenile Passage in the Chowchilla Bypass: During flood flows, juvenile salmon could be routed into the Chowchilla Bypass where habitat conditions would be hostile to completing successful downstream migration. Migration through the Chowchilla Bypass places juveniles in habitat with a plain bed channel, no riparian vegetation, limited to no food production, questionable connectivity, and passage over several drop structures and road or bridge crossings. Also during flood flows, when the radial gates are operated to manage the flow split in the San

Joaquin River side of the bypass, hydraulic conditions beneath the gates may preclude upstream passage of adults due to the velocity barriers that may develop within the structure.

3. San Mateo Avenue – This is a low flow crossing and consists of a single culvert and an earthen embankment supporting the gravel/sand roadbed. If the crossing is maintained, improvements at this crossing would be required to provide adequate fish passage, as well as to provide access across the river corridor during an acceptable range of Restoration Flows.

4. Mendota Dam and Mendota Pool – Mendota Dam creates the Pool, which backwaters several miles of the Reach. While Mendota Dam has an existing fish ladder structure (Figure 2-1), the dam is an impediment to fish migration because the ladder is non-operational and vertically inaccessible to up-migrating fish. During large floods, the flashboards are removed, the concrete sill is inundated and fish can gain access past Mendota Dam.

Figure 2-1
Mendota Dam fish ladder

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3.0 Goals and Objectives

Project goals and objectives provide a comprehensive vision for meeting the project purpose. Goals denote broad statements of intent that provide focus or vision for planning. The project goals provide a basis upon which specific objectives are formed. The objectives are intended to be well grounded, rooted in the project realities, and measurable to the extent possible so the project would have a quantitative means of evaluating project success. It should be noted that some biological objectives may not be quantifiable. Goals and objectives are presented for the following categories: flow conveyance, water supply, fish habitat and passage, habitat restoration, seepage, and geomorphology.

Many of the goals and objectives are interrelated. For example, flow conveyance will be necessary to support fish passage and habitat restoration. While goals and objectives are organized by category, it should be understood that the Project should meet all the goals and objectives.

The goals and objectives presented below were assembled from studies and documents prepared specifically for the SJRRP as well as non-SJRRP scientific and guidance documents representing the best available knowledge on the resource areas. Refinement of the Reach 2B goals and objectives is expected to occur as the alternatives development process progresses.

3.1 Flow Conveyance

Flow conveyance goals and objectives refer to the capacity of the channel, bypass, and structures to accommodate the range of Restoration Flows and flood releases. Restoration releases from Friant Dam are shown in Figure 3-1, and associated Restoration Flows expected in Reach 2 are shown in Figure 3-2.

Flow Conveyance Goal

Improve flow conveyance within Reach 2B between the Chowchilla Bifurcation Structure and the Mendota Pool Bypass to accommodate at least 4,500 cfs (Settlement Paragraph 11(a)(2)), and provide at least 4,500 cfs of flow conveyance in the proposed Mendota Pool Bypass (Settlement Paragraph 11(a)(1)).

Objectives

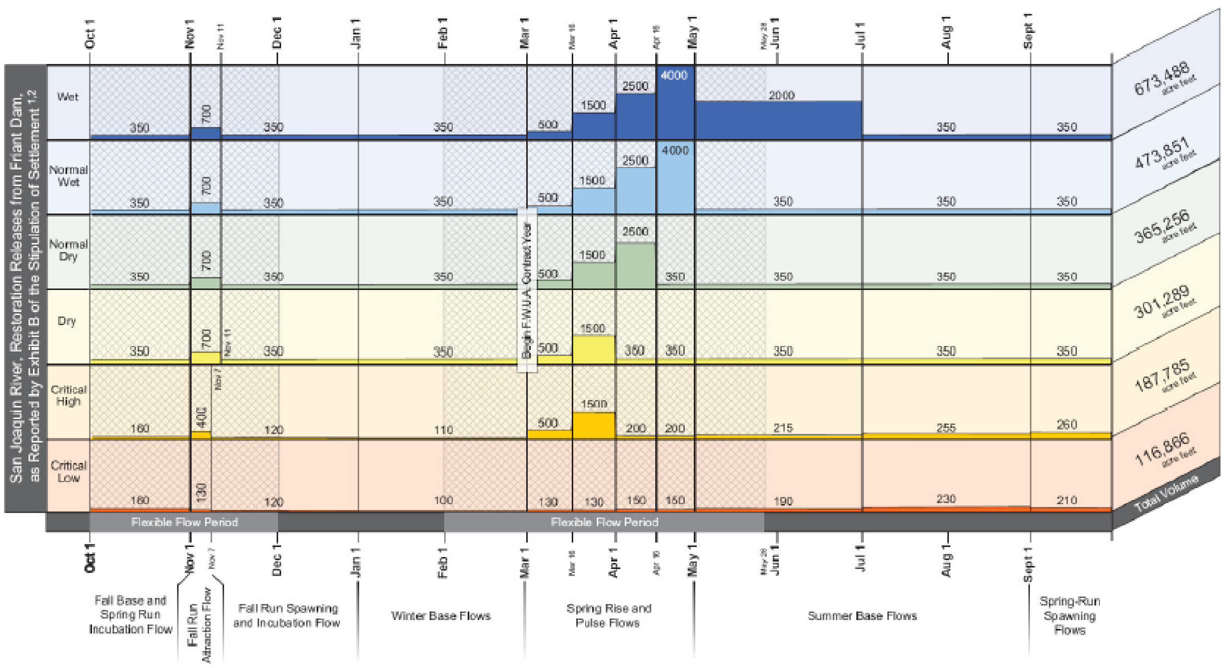
1. The entire Project channel/floodplain reach shall convey the full range of flows, up to at least 4,500 cfs.

2. Construct a bypass channel around Mendota Pool to convey the full range of flows, up to at least 4,500 cfs, to Reach 3.

3. The proposed San Mateo Avenue and Road 10 ½ crossings shall be designed to convey the full range of flows, up to at least 4,500 cfs.

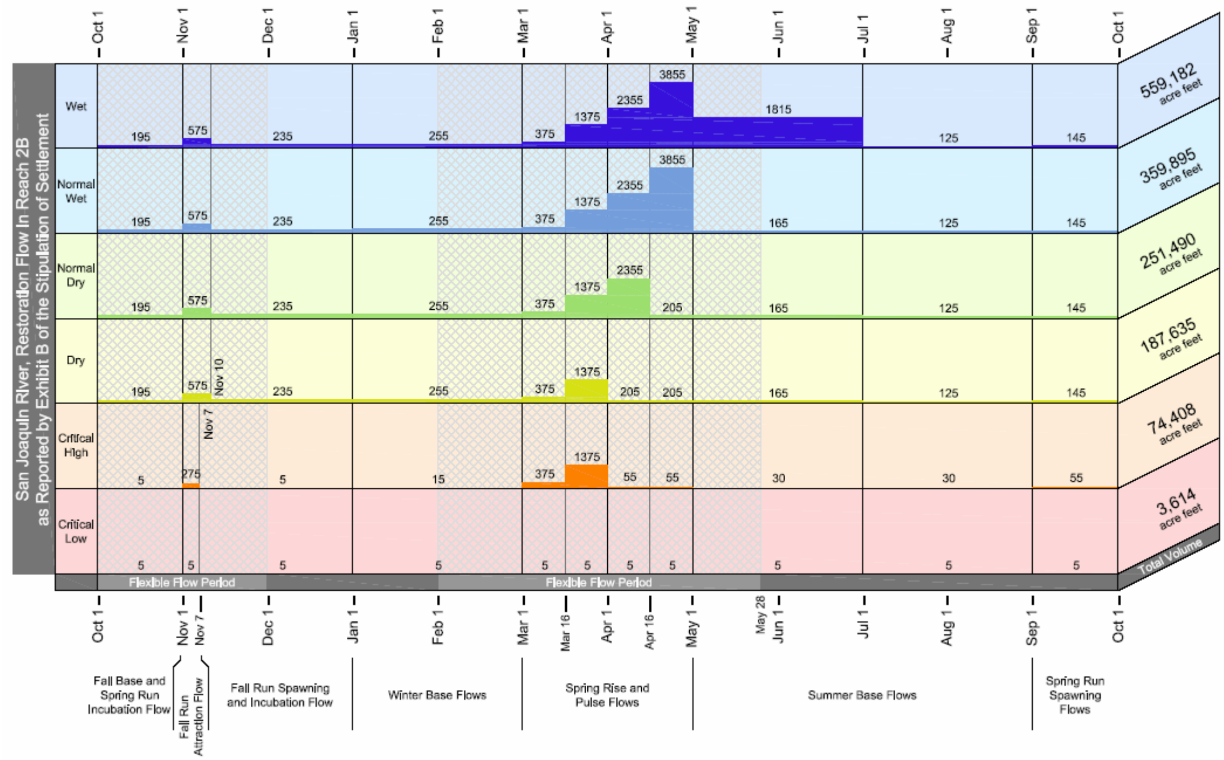
4. The proposed Mendota Pool Bifurcation structure shall divert the full range of flows (up to 4,500 cfs) into the Mendota Pool Bypass channel.

5. The proposed Mendota Pool Bifurcation Structure shall prevent, to the extent practicable, water loss below the normal pool elevations to maintain the Pool elevation under proposed conditions. The Pool currently operates at a water surface elevation of about 152.7 feet (NGVD29) or 155.0 feet (NAVD88).



Source: SJRRP, 2008

Figure 3-1
Restoration Flow hydrographs by restoration year type (Friant releases)



1 Hydrographs reflect assumptions about seepage losses and tributary inflows which are specified in the Settlement.

Figure 3-2
Restoration Flow hydrographs by restoration year type (Reach 2)

3.2 Water Supply

Water supply goals and objectives refer to provisions of the Project which will enable the continued ability to deliver contract water from Friant Dam to Mendota Pool via the San Joaquin River. Provisions for sufficient capacity outside the Project area and provisions for securing the water required by the contract are beyond the purpose of this Project.

Water Supply Goal

Accommodate water deliveries and flood releases to Mendota Pool at the Mendota Pool Bypass Bifurcation Structure (Settlement Paragraph 11(a)(1)).

Objectives

1. Under certain flood operation scenarios, it may be preferred to direct all or a portion of flood releases (see Section 4.2.3 for a summary of flood operations constraints) into the Pool. Should all flood flows be required in the Pool, the Mendota Pool Bypass Bifurcation Structure may require the flexibility to prevent or limit flows into the Mendota Pool Bypass.

2. The Mendota Pool Bypass Bifurcation Structure shall be capable of providing up to a 2,500 cfs delivery to the Pool when directed by the Secretary. During these delivery

flows, the structure shall have the flexibility to convey a range of flows (100-2,000 cfs) above the delivery flow through the Mendota Pool Bypass.

3.3 Fish Habitat and Passage

Restoration of aquatic habitat and fish passage for the purposes of establishing fish populations involves several interrelated processes:

- Determining the correct habitat components to include in the system
- Understanding how those components would function with the hydrology and geomorphology of the system
- Understanding how the flow routing and river conditions would interact to restore the hydrologic connectivity

Restoration of the San Joaquin River includes a fisheries goal to restore and maintain fish populations in “good condition” (Settlement Paragraph 2) with priority given to spring-run Chinook salmon populations, while fall-run Chinook populations are also included in the SJRRP fisheries goal. In this regard, an important component of the SJRRP is to convey flows for fish passage and migration from Reach 1 to Reach 5. Reach 1 contains all of the spawning and incubation habitat, and nearly all of the year-round rearing habitat for spring-run Chinook salmon (SJRRP 2009a). Reaches 2 through 5 (as well as the remainder of the San Joaquin River from the Merced River confluence to the Delta) would support fry to juvenile rearing during the outmigration life stages for spring- and fall-run salmon. Rearing during the outmigration life stage is described by the term “transient rearing.” A second component of the Project is to provide suitable habitat and passage conditions for upstream migrating adults.

SJRRP fisheries goals and objectives are presented in Chapter 3 of the *Draft Fisheries Management Plan* (SJRRP 2009a). Fishery restoration and management goals are applied throughout the Restoration Area – i.e., the San Joaquin River from confluence with the Merced River to Friant Dam. Individual reaches have different goals since the reaches are not all similar in habitat function and have somewhat different issues regarding flow conveyance and fish passage. Therefore not all restoration and management goals are applicable to all reaches.

The *Draft Fisheries Management Plan* divides goals into Population Goals and Habitat Goals. Goal statements are general statements identifying the elements necessary to restore the fish populations and habitat in the entire San Joaquin River Restoration Project Area. Each Population or Habitat Goal in the *Draft Fisheries Management Plan* is supported by a series of more detailed Objectives that in some cases provide a target restoration condition for the fish population or the habitat condition once the project is implemented and operating.

3.3.1 Fish Habitat Goals and Objectives

The following fish habitat goals and objectives apply to Reach 2B. The goals correspond to those found in the Fisheries Management Plan for the Restoration Area and for individual reaches (Table 3-1).

Fish Habitat Goal 1

Provide functional rearing habitat for juvenile salmon for the purposes of transient rearing during outmigration.

Objectives

1. Create habitat conditions (suitable depth, velocity, and temperature) for juvenile foraging during winter and spring.

2. Minimize artificial structures that provide areas for fish and bird predation.

3. Create habitat conditions (suitable depth, velocity, and temperature) that support successful outmigration.

4. Minimize population losses to diversion within Reach 2B.

Fish Habitat Goal 2

Provide habitat to facilitate upstream migration of adult Chinook salmon.

Objectives

1. Provide opportunities for resting/refuge pools at appropriate intervals throughout Reach 2B.

2. Improve habitat conditions (suitable depth and velocity) that support successful upmigration.

Fish Habitat Goal 3

Provide habitat to support native fishes other than salmon.

Objectives

1. Create habitat conditions to support fish species historically native to Reach 2B

2. Modify channel to enhance existing habitat for native fishes at the restoration low flow condition.

3. Provide connectivity within the river system to support native fish movements

Fish Habitat Goal 4

Restore in-channel vegetative communities in support of the establishment of an anadromous fishery.

Objectives

1. Increase, to the extent practicable, freshwater marsh, perennial and seasonal wetlands in the river corridor for the purposes of enhancing slow velocity habitat conditions for fish.

2. Promote the development of shaded aquatic riverine habitat (e.g. by including woody riparian species such as sandbar willow (*Salix exigua*) and buttonbush (*Cephalanthus occidentalis*)).

3. Include sources for instream woody material at the August and February mean water surface elevations to support suitable habitat for juvenile stages of desired fish species.

3.3.2 Fish Passage Goals and Objectives

The following fish passage goals and objectives are applicable to Reach 2B.

Fish Passage Goal 1

Provide flow routing and fish passage at each of these instream structures and potential future structures:

- Chowchilla Bifurcation Structure
- San Mateo Avenue and Road 10 ½ crossings
- Mendota Pool Bypass Bifurcation Structure
- Mendota Pool Bypass Fish Screen
- Mendota Pool Bypass Fish Barrier
- Mendota Pool Bypass Drop Structures

Objectives

1. Develop preferred fish migration routes based on triggers for the range of Restoration Flows, flood releases, and water deliveries along with the associated flow routing.

2. Protect migrating juveniles from entering the Mendota Pool for the range of Restoration Flows.

3. Protect migrating juveniles from entering the Chowchilla Bypass for the range of Restoration Flows.

4. Direct upstream migrating adults out of Reach 3 and into the Mendota Pool Bypass at the confluence with Reach 3.

5. Ensure up and downstream fish passage during migration flows through each bifurcation structure, the grade control structures in the Mendota Pool Bypass, and the San Mateo Avenue and Road 10 ½ crossings in terms of appropriate timing and duration, minimum flow depth, maximum velocity, and entrance and exit conditions.

Table 3-1
Restoration Area Habitat Goals and Compatible Reach 2B Habitat Goals

Fish Management Plan Habitat Goal	Applicability	Compatible Initial Options Reach 2B Habitat Goals
Restore a flow regime that (1) maximizes the duration and downstream extent of suitable rearing and outmigration temperatures for Chinook salmon and other native fishes, and (2) provides year-round river habitat connectivity throughout the Restoration Area.	Restoration Area	Provide functional rearing habitat for juvenile salmon for the purposes of transient rearing during outmigration.
Provide adequate flows and necessary structural modifications to ensure adult and juvenile passage during the migration periods of both spring-run and fall-run Chinook salmon.	Restoration Area	Provide functional rearing habitat for juvenile salmon for the purposes of transient rearing during outmigration. Provide habitat to facilitate upstream migration of adult Chinook salmon.
Provide suitable habitat for Chinook salmon holding, rearing, and outmigration during a variety of water year types, enabling an expression of a variety of life history strategies. Suitable habitat will encompass appropriate holding habitat, spawning areas, and seasonal rearing habitat.	Restoration Area	Provide functional rearing habitat for juvenile salmon for the purposes of transient rearing during outmigration.
Provide water-quality conditions suitable for Chinook salmon and other native fishes completing their life cycle without lethal or sublethal effects.	Restoration Area	Provide functional rearing habitat for juvenile salmon for the purposes of transient rearing during outmigration.
Reduce predation losses in all reaches by reducing the extent and suitability of habitat for nonnative predatory fish.	Restoration Area	Provide habitat to support native fishes other than salmon
Restore habitat complexity, functional floodplains, and diverse riparian forests that provide habitat for spawning and rearing by native resident species during winter and spring.	Restoration Area	Provide functional rearing habitat for juvenile salmon for the purposes of transient rearing during outmigration.
Goal A: Provide flows sufficient to ensure habitat connectivity and allow for unimpeded upstream passage and outmigration	Reaches 2-4	Provide flow routing and fish passage at current structures and potential future structures. Provide flow routing and fish passage in the river channel.
Goal D: Minimize juvenile entrainment losses	Reaches 1-5	Provide flow routing and fish passage at current structures and potential future structures.
Goal F: Eliminate fish passage barriers and minimize migration delays	Reaches 1-5	Provide flow routing and fish passage at current structures and potential future structures. Provide flow routing and fish passage in the river channel.
Goal G: Provide suitable water temperatures for upstream passage, spawning, egg incubation, rearing, smoltification, and outmigration to the extent achievable considering hydrologic, climatic, and physical channel characteristics	Reaches 2-5	Provide functional rearing habitat for juvenile salmon for the purposes of transient rearing during outmigration. Provide habitat to facilitate upstream migration of adult Chinook salmon.
Goal Q: Ensure suitable quantity and quality of floodplain and riparian habitat to provide habitat and food resources for Chinook salmon and other fishes	Restoration Area	Provide functional rearing habitat for juvenile salmon for the purposes of transient rearing during outmigration.

Fish Passage Goal 2

Provide flow routing and fish passage in the river channel for upstream migrating adults and emigrating juveniles.

Objectives

6. Encourage the development of channel geometry to provide minimum depth of at least 12 inches through the river thalweg over at least 10 percent of the cross section width during low flow conditions occurring in the migration season.

3.4 Habitat Restoration

Habitat restoration of Reach 2B of the San Joaquin River would focus on incorporating riparian and floodplain habitat communities (Settlement Paragraph 11(a)(2)) in support of restoring and maintaining a fish population in "good condition" (Settlement Paragraph 2). Adjacent upland habitat communities are also considered important for the long-term health and diversity of the in-stream, riparian, and floodplain communities. Habitat Restoration would consider the natural community structure, function, and capacity for change, within the constraints of flow regulation and other water and land management activities. To the extent feasible, efforts would focus on restoring channel and floodplain processes of water, sediment, and organic matter cycling in the reach. Physical reconstruction would be required to initiate these changes. The altered dynamics would promote ecosystem processes that create and maintain riparian habitats suitable for well-distributed, viable populations of native fish, plants and animals.

The key principles for this project would begin with restoration of ecosystem processes wherever possible, and restructuring of the new stream channel and floodplain geometry to function under the proposed flow regime. The aim of improving geomorphic function is to benefit long-term ecosystem processes that support native riparian habitats and aquatic species and that promote development of a dynamic, self-sustaining ecosystem to the greatest extent possible.

Habitat Restoration Goal

Encourage the establishment and growth of riparian and floodplain vegetation and habitat complexes and maintain existing vegetation, to the extent practicable.

Objectives

1. Preserve, to the extent practicable, any remaining patches of functional native vegetation for the purposes of maintaining habitat in Reach 2B while new vegetation becomes established, minimizing short-term project impacts, and supplying propagules for natural vegetation recruitment.

2. Restore floodplain habitat by increasing the acreage of riparian woodland, forest and scrub for the purposes of providing multiple benefits to the riparian ecosystem, such as filtering of nutrients and fine sediment, stabilizing channel banks, shading the river channel, and others.

3. Include, to the extent practicable, a native vegetative buffer (e.g. upland habitats like valley oak woodland and elderberry savanna) on riparian and floodplain habitats to protect water quality and the health of the adjacent riparian vegetation alliances from chemical drift and other potential external impacts to the health of the fish population.

4. Reduce the acreage and distribution of invasive, non-native species (e.g. giant reed-grass (*Arundo donax*), scarlet wisteria (*Sesbania punicea*), castor bean (*Ricinus communis*), and poison hemlock (*Conium maculatum*)) in order to diminish their range, lessen their competition with native plants, avoid alterations to riparian habitat value and ecosystem function, and protect fish and wildlife.

5. Restore a riparian corridor with improved ecological functioning, increased longitudinal connectivity, increased average width of riparian vegetation on both sides of the river, and larger, contiguous patches of woody riparian vegetation and instream woody material.

3.5 Seepage

Seepage goals and objectives are included to address the prevention of damage or losses to agricultural land outside the Project area. Increased water levels in the Project area as a result of Restoration Flows may have a negative effect on the production value of adjacent lands due to the corresponding increase in water table. These effects would be assessed and addressed as part of the Project according to the goals and objectives. The recommended objectives should be treated as preliminary recommendations, recognizing they would very likely be revised as more is learned about the local seepage needs and additional groundwater modeling, water level, and other data are analyzed to better quantify thresholds.

Seepage Goal

The Program Environmental Impact Statement/Environmental Impact Report (PEIS/R) is anticipated to state that the general seepage goal of the SJRRP is to reduce or avoid adverse seepage impacts to third parties resulting from the Interim or Restoration flows. The SJRRP Draft Seepage Management Plan (SJRRP 2009b) describes the monitoring and operating guidelines for the reduction or avoidance of potential seepage-related effects.

Objectives

1. During the growing season, avoid impacts to crops from water logging by conforming to the minimum depth to water thresholds developed in the Draft Seepage Management Plan (SJRRP 2009b).

2. Avoid impacts to crops from salinity by conforming to the maximum soil salinity concentration developed in the Draft Seepage Management Plan (SJRRP 2009b).

3. Prevent any significant levee stability issues from standing water, boils, or piping that may compromise the short- or long-term stability of the levees.

3.6 Geomorphology

Geomorphology goals and objectives are aimed at balancing the available water and sediment loads with the channel planform, slope, cross sectional dimensions, and vegetation. The dynamic nature of a river system includes both the physical processes and the attributes (or form) that the target aquatic species depend on.

The focus of the goals and objectives is to utilize geomorphic processes and develop a plan for long-term (including individual flow events and changes over time) channel, floodplain, levee, and structure stability based upon current and future socio-economic, physical, and biological constraints. An understanding of the fluvial geomorphic processes in the Project area will also inform the potential of the Project to meet the Fish Habitat and Passage and Habitat Restoration goals and objectives.

Geomorphology Goal 1

Provide for long-term stability of required riverine structures, such as diversions, levees and any bed and bank stabilization measures.

Objectives

1. Minimize erosion and scour problems, and associated maintenance and cost requirements for management agencies.

2. Minimize the risk of potential structural failure due to uncertainties inherent in hydrologic and geomorphic sciences and practices.

Geomorphology Goal 2

Reestablish a functioning river morphology which, to the extent possible, promotes long-term stability of the river system and which supports fish habitat and passage goals by utilizing hydro-geomorphic processes in conjunction with Restoration Flows.

Objectives

1. Establish the optimum channel and floodplain configuration (morphology) that is consistent with the future flow and sediment supply regimes.

2. Incorporate vegetation to the extent possible to protect channel banks, while maintaining the channel and floodplain capacity requirements.

3. Provide geomorphic features that support fish management goals for migrating and transient rearing habitats.

4. Enable the establishment and maintenance of diverse bed features (e.g. pools) and channel structure (e.g. large woody debris) through natural processes.

5. Promote the establishment of a single-thread, low-flow channel to provide for fish passage through natural processes.

1. Promote for periodic inundation of floodplain surfaces at the proper frequency for fish access and transient rearing.

4.0 Opportunities and Constraints

Implementation of the Project may provide opportunities for improvements beyond the scope of the project purpose. These opportunities may be incorporated or accommodated in the Project incidentally or as a part of project alternatives. While incorporation of the opportunities into the Project is not required, some opportunities may provide broad-scale benefits to the terrestrial and aquatic ecosystem of the San Joaquin River or to the CVP and SWP water supplies and flood management and may be considered for inclusion to the extent that they do not negatively affect the ability of the project to meet the Project Purpose and Need.

In addition, some constraints on the planning process would limit the ability to implement certain Project options and future alternatives. In general, constraints limit the range or extent of options being considered, and in some cases, limitations set by constraints may be used as a basis for development of evaluation criteria to be used during alternatives formulation to examine the extent to which certain options meet project goals and objectives.

4.1 Opportunities

4.1.1 Habitat Improvement for Other Native and Special Status Species

The restoration of the San Joaquin River for the purposes of reintroduction of Chinook salmon to reaches between the Merced River and Friant Dam may incorporate restoration of native floodplain and in-channel habitats. Restoration of these habitats is one of the Project purposes and is likely to benefit other native and potentially special status terrestrial and aquatic species such as Swainson's hawk (*Buteo swainsoni*), Valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*), etc. Benefits to other native species would be realized through the re-introduction of perennial base flows as well as seasonal high flows in the River, which in turn would promote the establishment of indigenous riparian vegetation. Well-established native plant communities in the floodplain would support rich and diverse native flora, including potentially, special status plant species, would effectively prevent invasive vegetation encroachment, and would provide foraging habitat and shelter for native wildlife species.

Specific opportunities include the following:

- Restoring river-floodplain connectivity and longitudinal connectivity of riparian vegetation near the channel (without major breaks in the distribution of woody vegetation except where natural conditions prevent establishment of native trees or shrubs) that can provide cover and habitat for a variety of wildlife species
- Creating or maintaining a combination of diverse habitats required by selected wildlife species, such as species that depend on concurrence of aquatic, wetland

or riparian, and upland habitats to meet various life stage requirements (e.g., western pond turtle, Swainson's hawk)

- Enhancing landscape connectivity between the river corridor and adjacent areas of ecological significance (e.g., wildlife refuges and other protected lands, biodiversity "hotspots," adjacent sloughs or tributary channels with existing riparian habitat, wildlife movement corridors, and private natural preserves such as the Mendota Wildlife Area)
- Protecting, restoring, or enhancing special status vegetation alliances and plant species

4.1.2 Open Space & Mitigation

Opportunities for open space and wetlands/waters and habitat/species mitigation are available in the areas south of the proposed Mendota Pool Bypass. It is expected that agricultural land between the Mendota Pool Bypass configuration and the existing river would not support production in the future condition due to lack of drainage. These lands may be acquired as part of the project due to the impacts to agricultural utility, and therefore, may be available for open space conservation and mitigation. Some of these lands have been fallowed in anticipation of the acquisition.

Open space and mitigation may also be available in the two river bends (west and east loops) near the upstream end of the Project. These areas are occasionally used for cattle grazing but are substantially non-native grasslands. Potential exists for habitat improvements to be incorporated in these areas that may provide some mitigation credit for the Project.

The property along the south bank at the upstream end of the Project currently exhibits natural topography, is connected to the river corridor, and management of this land is virtually unchanged since pre-Friant Dam times. It is believed that high quality, native species habitat is extensive on this property, which appears to extend in similar fashion south to Alkali Sink Ecological Reserve. Significant mitigation and conservation opportunities are available on this parcel, and the potential to include this parcel with the Project could be explored further.

Finally, opportunities for open space and mitigation may be available on portions of parcels that may be acquired for the Project but are outside of the area required to build the Project. For example, a whole parcel may be purchased for the Project even though the full extents are not required to build the project. This may occur when the property which remains outside the Project extents has limited use or value for agricultural production.

4.1.3 Recreation

Existing water-related recreational opportunities on the Reach 2B segment of the San Joaquin River are limited because the upper half of the River reach is dry most years, and even the downstream inundation associated with the Pool water is drained bi-annually for several weeks. Moreover, areas immediately adjacent to the riverbed are privately owned, and public access is limited.

Currently, the nearest vehicle access to the riverbed is San Mateo Avenue, but private land must be crossed to obtain direct access to the river because the public right-of-way ends approximately 3,600 feet south of the channel, and the portion of the road that crosses the river is privately held. The primary nearby water-related recreational opportunities are outside the immediate Reach 2B channel area at Mendota Pool, approximately four miles from the San Mateo Avenue crossing, which offers angling.

Future recreational activities along Reach 2B would be similarly limited if the Project were not implemented. While population in the Project area and vicinity would likely increase at rates common for the west side of the San Joaquin Valley, the resulting increased recreational demands under No-Action/No-Project conditions from population growth would be directed to nearby recreational venues, including Mendota Pool and San Luis Reservoir (approximately 40 miles to the northwest).

Implementation of the Reach 2B Project may offer some expansion in recreational opportunities. However, it would be necessary to consider these opportunities relative to the primary SJRRP purposes of conveying flows for anadromous fish passage (upstream and downstream migration of salmon) and providing suitable habitat for fish migration and transitory rearing. Habitat restoration goals for Reach 2B may be found in Section 3.4 of this document. Consequently, if implementation of the Project would provide greater public access to Reach 2B, it is expected that appropriate restrictions on fishing and other activities in and near the water that could endanger salmon or result in trespassing on private lands would be implemented.

4.1.4 Water Quality

Implementation of the Project has the potential to improve water quality to the extent that native aquatic, riparian, and floodplain vegetation may remove and uptake some pollutants dissolved in San Joaquin River base flows. Greater water quality improvements may be realized through nutrient cycling and pollutant uptake following sediment deposition during high flow events where floodplains are inundated. Due to the lack of water quality impairment at Millerton Lake and the limited agricultural return flow locations upstream of the Project, the future water quality in the Project area may not be significantly impaired.

4.1.5 Education

If implementation of the Project would provide greater public access to Reach 2B, the Project could also incorporate opportunities for education for students, land owners, restoration specialists, recreational enthusiasts, and the general public. River processes, native wildlife and habitats, water management, and ecological restoration are all topics that could be incorporated into education campaigns involving interpretive signage, trails, and field trips as appropriate.

4.1.6 Flood System

The Lower San Joaquin River Flood Control Project (Flood Control Project), authorized by Congress in 1944 to protect irrigated agricultural lands and associated developments, is operated and maintained by the Lower San Joaquin Levee District (Levee District) under the Flood Control Project’s Operation and Maintenance Manual for Levee, Irrigation and Drainage Structures, Channels and Miscellaneous Facilities (Flood Operation Manual). The Project offers some opportunity for improving the flood system and Flood Operation Manual within the San Joaquin River Reach 2B. The current channel capacity of 2,500 cfs would be increased to at least 4,500 cfs. Although not analyzed as part of this TM, the increased conveyance may provide opportunities for improving flood operations during certain flood scenarios. The ability to accommodate higher flows during flood releases is dependent on the downstream capacity of the system. Currently, the Project will not alter the Flood Operations Manual.

4.2 Constraints

4.2.1 Settlement and Act Requirements

The Settlement requirements and conditions of the Act place legal constraints on the Project. Specifically, Settlement Paragraphs 11(a)(1) and 11(a)(2) require the construction of a bypass around Mendota Pool and increasing capacity to 4,500 cfs in both the proposed bypass as well as Reach 2B.

4.2.2 Other Legal and Regulatory Compliance

The Project must comply with various Federal, State, and local laws, regulations, executive orders, and policies. The alternatives developed for the Project must demonstrate compliance with applicable regulatory requirements as part of the NEPA/CEQA process. Additionally, regulatory compliance is needed to obtain the many permits and approvals that would be required prior to project construction. Many of the laws and regulations, such as the Clean Air Act and the Clean Water Act, set thresholds or standards for certain types of impacts associated with a project. Consideration of these thresholds early in the alternatives formulation process is important in order to avoid adverse environmental effects, project delays, and costly mitigation. Table 4-1 presents a brief list of applicable laws, regulations, executive orders, and policies that the Project must comply with. These regulatory requirements would be considered throughout the alternatives formulation process and would be updated as the options are further refined.

4.2.3 Operations for Flood Releases and Water Deliveries

The Project will consider three different conditions under which releases are or would be made from Friant Dam: Restoration Flows, flood releases, and water deliveries. While the Project is primarily focused on building the reach for conveyance of the Restoration Flows, the factors and conditions surrounding the management of flood releases and water deliveries to Mendota Pool are constraints on the available Project options, particularly for structures. The PEIS/R is anticipated to include information on the Program approach to flood operations and water deliveries.

Table 4-1
Laws, Regulations, Executive Orders, and Policies

Federal	State	Local
▪ Bald and Golden Eagle Protection Act ▪ Clean Air Act ▪ Clean Water Act, Sections 401, 402, 404 ▪ Endangered Species Act, Section 7 ▪ Executive Order 11988, Floodplain Management ▪ Executive Order 11990, Protection of Wetlands ▪ Executive Order 12898, Environmental Justice ▪ Executive Order 13007, Indian Sacred Sites ▪ Executive Order 13112, Invasive Species ▪ Farmland Protection Policy Act ▪ Fish and Wildlife Coordination Act ▪ Indian Trust Assets (U.S. Department of the Interior Departmental Manual Part 512) ▪ National Environmental Policy Act ▪ National Historic Preservation Act, Section 106 ▪ Magnuson-Stevens Fishery Conservation and Management Act ▪ Migratory Bird Treaty Act ▪ Rivers and Harbors Act, Section 9, (33 USC 401), Section 10 (33 USC 403) and 14 (33 USC 408)	▪ 23 California Code of Regulations 6 Central Valley Flood Protection Board Organization, Powers and Standards ▪ California Clean Air Act ▪ California Endangered Species Act ▪ California Environmental Quality Act ▪ California Fish and Game Code, Section 1602 ▪ California Land Conservation Act ▪ California Office of Historic Preservation ▪ Environmental Justice Public Resources Code 65040.12(e) ▪ Native Plant Protection Act ▪ Porter-Cologne Water Quality Control Act ▪ Public Resources Code 6501-6509 Lease of Public Lands under State Lands Commission ▪ Surface Mining and Reclamation Act	▪ Fresno County Code 13.08 Private Improvements within Road Rights-of-Way ▪ Merced County Code Section 13.30.101 – Encroachment Permit ▪ San Joaquin Valley Air Pollution Control District Rule 2010 – Authority to Construct/Permit to Operate

The Exchange Contract (Reclamation 1967) defines that a maximum of 2,316 cfs may be required to be delivered to the Pool via Reach 2B, and also defines to varying extents maximum monthly flow magnitudes and volumes that may be requested for delivery. To date, water deliveries to the Pool have never been made via releases from Friant and the San Joaquin River; in addition, current planning models do not anticipate any future occurrence of a Friant delivery. Due to the lack of precedent and predictive cases, the timing of these delivery requests and the delivery duration are unknown, and it is also unknown what coincident flow may be available to meet Restoration Flows. Therefore, the initial options and subsequent alternatives for the Mendota Pool Bypass Bifurcation Structure would need to incorporate the flexibility to divert a range of flows to the Mendota Pool Bypass, the Pool, or both. The structure may also need to incorporate fish screens that would function under a variety of flow ranges and splits to screen fish from the Pool.

Flood operations are managed from a risk perspective for the purposes of protecting public health and safety and property. The specific flood operations in Reach 2B are dependent on flow entering the Pool from Fresno Slough, as well as the flow at the Chowchilla Bifurcation Structure. The O&M manual recommends flood operations based on flow rates in Reach 2B for varying flow magnitudes in Fresno Slough and the Chowchilla Bifurcation Structure (Reclamation Board 1969). The levee districts have the latitude to operate facilities in the manner that will best protect public health and safety and property. Since the project specific EIS/Rs establish the improvements that would safely convey the Restoration Flows in the various reaches, it is assumed that conveyance of Restoration Flows coincident with flood flows are not in conflict, and the system can be managed in a manner that will protect public health and safety and property while also maintaining the flexibility to provide some level of flow in the principal migration pathways (i.e., Mendota Pool Bypass). However, future agreements and/or changes in the Flood Operation Manual would be necessary to provide for this type of management. These agreements and/or possible changes to the Flood Operation Manual are outside of the scope of this Project and would likely undergo separate review and approval, if executed. For the purposes of this evaluation it is understood that protection of public health and safety and property takes precedence and certain conditions may arise where ensuring ideal flows and pathways for fish migration may not be obtainable.

As part of development of the options, the following order of priorities for flow management was considered.

- 1st Priority: Flood operations for the protection of public health and safety and property.
- 2nd Priority: Water deliveries to the Exchange Contractors.
- 3rd Priority: Restoration Flows.
- 4th Priority: Flood releases to meet water supply delivery contracts.

Under this management prioritization, several specific scenarios may occur, but in general, it is assumed that:

- Flood releases from Friant may be routed through the Mendota Pool Bypass pending other flood operations considerations (e.g., Fresno Slough contributions) or they may be routed through both the Mendota Pool Bypass and the Pool
- Water deliveries may reduce Restoration Flows in the Mendota Pool Bypass to a maximum of 2,000 cfs, given the 4,500 cfs total reach capacity and the 2,500 cfs delivery, but otherwise do not restrict Restoration Flows in the reach

4.2.4 Fish Passage

The following is a summary of operational and site constraints that may limit the ability of the proposed options to meet the project goals and objectives pertaining to fish passage that are linked to fish passage in the channel and at structures under Restoration and flood flows:

1. Flow routing, particularly during flood and Pool delivery scenarios will affect the range and types of options presented. Since the reach will be conveying flow for three purposes (floods, water deliveries, and fish), the various structure operational scenarios need to be understood such that new structures and modifications of existing structures can be configured to provide adequate conditions for fish over the widest range of potential flow routing scenarios. Channel and habitat connectivity

should be considered during flood flows analysis in order to support meeting fishery restoration objectives.

2. Low flow conditions (100-350 cfs releases at Friant Dam) may preclude passage up or downstream for salmon in the channel due to limited depth of flow in the wide and sandy channel of Reach 2B. Reach 2B presently has very poor aquatic habitat to support fish. The channel is wide, with little morphological development. Substrate is homogenous and aquatic habitat features are limited to minor bars and shallow depressions. The rate of development of riparian vegetation may be a key in improving channel conditions. Encouraging the establishment of a low flow channel in a sand bed without benefit of riparian vegetation may be a challenge. Recreational activities in Reach 2B upstream of San Mateo Avenue crossing may preclude re-establishment of riparian vegetation and a functional channel and floodplain (see Section 4.2.11).

3. The number of existing and proposed structures in Reach 2B could become a factor in the success of migrating salmon. While potential structures will be designed to meet NMFS and DFG criteria for passage, and existing structures may be modified to meet these criteria, nearly all structures result in some level of stress to migrating fish, either through localized change in hydraulics or sites for potential predation. The channel, floodplain, and structures need to be designed to allow passage flows to be sustained over the structures for a sufficient period of time to provide for fish to pass over all the structures on their upstream movements into Reach 2A and for downstream passage of juveniles into Reach 3.

4. Routing of flood flows should consider effects to the salmon population with the understanding that the foremost priority during flood operations will be for the protection of public health and safety and property (see Section 4.2.3). Flood routing decisions are not made by the SJRRP, but are carried out by other entities, including the Central Valley Flood Protection Board and the Levee District.

4.2.5 Special Status Species

There are known occurrences and the potential for occurrences of special status plant and wildlife species native to the San Joaquin River corridor and specifically the area in and adjacent to the Project. Impacts to species and their habitats are regulated through Federal programs via the Endangered Species Act (ESA) and through State programs via the California Endangered Species Act (CESA). By law, those responsible for the Project must incorporate assessment, coordination, permitting, and avoidance, minimization, and mitigation for impacts to special status species and their regulated habitats.

4.2.6 Cultural and Historical Resources

Project has the potential to affect cultural and historical resources within the Project area due to proposed grading, construction of structures, land use change, and possible increased extent and depth of flooding. An assessment of the presence of cultural and historic resources would be addressed in a separate TM. Impacts to cultural and historical resources within the area of potential effect of the Project must be avoided, minimized, or mitigated, as applicable.

4.2.7 Land Use/Agriculture and Socioeconomic/Environmental Justice

Land Use/Agriculture

Implementation of the Project would have a direct impact on landowners and land uses proximate to Reach 2B. The land proximate to Reach 2B is primarily in agricultural production with permanent (high value) crops. The land is within the water service areas of Columbia Canal Company, (one of the San Joaquin River Exchange Contractors), the Aliso Water District, and the Farmers Water District. Much of the agricultural land is planted in permanent crops, including almonds, pistachios, palms, and wine grapes (Houk 2009a). Annual crops are primarily corn and silage (in support of the local dairy industry) alfalfa, and melons. None of the affected land is typically used to grow vegetables.

Detailed information on annual and permanent crops grown in the affected area would be obtained from the water agencies in whose service areas the affected lands lay, to more fully evaluate Project Options. While DWR prepares maps showing crops grown at different locations in various counties, the maps for the study area are not current; the most recent Fresno and Madera County coverages are from 2000 and 2001, respectively. Additionally, crop reports from the Fresno County Agricultural Commissioner and the Madera County Department of Agriculture are at a county level, with no resolution below that level. Since available data from DWR and the County crop reports are either dated or not of sufficient detail, it is recommended that crop data be obtained from the water agencies.

Socioeconomic/Environmental Justice Issues

Environmental justice is defined as the potential for a project to disproportionately affect disadvantaged populations including low income and minority populations. The potential for the Reach 2B Project to affect these groups would be associated with economic impacts, as few people live in the affected Project area. Because the riverbed is partially dry and public access is very limited, little potential exists for the Project to affect subsistence fishing activity by disadvantaged populations.

Data from the 2000 Census of Population and Housing show that agriculture and agriculture-related industries provide most of the household employment in the area.

Construction, implementation, and maintenance of the Reach 2B Project have the potential to adversely affect agricultural land proximate to the River because of the land acquisition that would be required to construct both levee setbacks for the purposes of increasing channel capacity and creating habitat to support anadromous fisheries. The number of acres affected would vary by option/alternative. The loss of agricultural production land may adversely affect the socioeconomic and environmental justice characteristics of the affected area. Any reduction in agricultural land use can be expected to affect not only agricultural production itself, but also the many industries which support and are supported by production agriculture. Construction-related activities and purchases of goods and services in the project area would at least partially offset the reductions in agricultural economic activity. The economic areas most likely to be affected include the incorporated cities of Firebaugh and Mendota, both in Fresno County, and unincorporated areas in both Fresno and Madera Counties.

4.2.8 Seepage

The Project design criteria will address any seepage effects on adjacent agricultural lands due to the increased flow frequency, quantity, and duration in the River channel and floodplain under the Restoration Flows. Seepage is a concern for levee stability and because it can cause damage to agricultural crops through increased root zone groundwater saturation and/or increased soil salinity which may decrease yield or cause die-off of crops, thus affecting lands outside of the direct Project footprint. An analysis of the potential for seepage and the monitoring and action thresholds for the Project area has been developed in the Draft Seepage Management Plan (SJRRP, 2009c), but further development of this plan is expected.

4.2.9 River Crossings

One river crossing exists in Reach 2B at San Mateo Avenue. This crossing is a low water crossing, and it is on private land but connects to a public right-of-way in Fresno County. In addition, a future crossing at Road 10 ½ is anticipated over the bypass channel (Settlement and Compact Alignments). Historically, access across the river at San Mateo Avenue could occur during most times because the channel flowed infrequently. With the introduction of the Restoration Flows, access may become limited because the Restoration Flows could overtop the roadway surface.

The need to maintain the San Mateo Avenue crossing, if needed and appropriate, provide the Road 10 ½ crossing, and limit overtopping flows at both will constrain the type of crossing design as well as affect the construction and maintenance costs. Coordination with landowners and Counties should be conducted to help determine access needs (times of year, equipment types, etc.) and crossing frequency. The crossings also have the potential to affect fish passage, sediment transport, and geomorphic processes.

4.2.10 Geomorphology

The geomorphic constraints for this project include channel base elevations, longitudinal slope, and the imposed flow and sediment supply regimes. Channel base elevations at the up and downstream ends of the Project are fixed because the Project must tie into channel elevations of Reach 2A and 3. Actual slope of the channel is dependent on channel length or sinuosity. In the case of the proposed Mendota Pool Bypass Settlement and Compact alignment options, the length of the river channel would be shortened over the current length. This in turn increases the slope of the bed profile between the two bypass tie-in locations. Increases in slope effectively increase the sediment transport capacity of the reach, which may result in erosion and degradation.

To maintain long-term stability, the incoming sediment supply must be transported through the Project reach maintaining sediment continuity. The incoming sediment load is a boundary condition, and Project constraint, defined by the future flows and sediment transport from the upstream reaches. To maintain stability during discrete events (particularly at structures), the transient sediment regime during individual high and low flow events must also be understood.

Rivers are dynamic systems that change over time and space due to imposed environmental conditions. Meander migration is a natural process of a rivers lateral movement across valley floors. It is a result of erosion on the outer bank of meander bends and deposition on the inner bars forming floodplain surfaces. Migration is a complex process not fully understood involving various types of movement. As a river channel migrates, ideally, it maintains its general shape (width, depth and slope) or "dynamic equilibrium".

Meander migration may not be a desirable physical process to reestablish. However, some form of erosion and deposition is expected in rivers and stream systems. The wider the floodplain alternative, the more natural lateral migration processes in river alignment may be accommodated. As the corridor width of the options decreases, the river channel is constrained to its current location, and the need for engineered structures to restrict migration increases.

4.2.11 Recreation

While no direct public access to the river exists in this reach, the nearest vehicle access is San Mateo Avenue, which is a public right-of-way that ends approximately 3,600 feet south of the channel. The portion of San Mateo Avenue that crosses the river is privately held. Therefore, existing recreational use of the river requires crossing private land.

Existing recreational activities occurring on the site primarily consist of operating off-highway vehicles (OHVs) in areas upstream of the San Mateo Avenue crossing. OHV use in the river corridor post-restoration is potentially a significant site constraint. With the fine sand bed that exists in the river channel, vegetation is the only means of stabilizing the low flow channel, and establishment of vegetation would be greatly hindered by OHV use, which would continuously remove emerging vegetation and prevent establishment of successional vegetation (see Figure 4-1). The prevention of the establishment of vegetation has strong implications for geomorphic processes as well as for providing appropriate fish habitat. Prevention of unauthorized vehicular access to the restoration area would be key to encouraging the establishment of vegetation, wildlife habitats, and geomorphic stability.

Figure 4-1
Aerial view of Reach 2B showing OHV tracks

4.2.12 Illegal Dumping

Illegal dumping is occurring at the San Mateo Avenue crossing, which is the primary public access point to the river in Reach 2B. Large areas on both the upstream and downstream sides of this crossing are affected by the dumping of trash, furniture, appliances, and other items. This material has the potential to not only affect the operation and maintenance of existing and proposed structures (by clogging or fouling San Mateo Avenue culverts, Mendota Pool Bypass Bifurcation Structure, etc.), but could also have a large effect on water and habitat quality. Additionally, the costs associated with characterizing, removing, and disposing of any contaminated material are potentially significant. The effects on structures and water and habitat quality have repercussions for the ability of the reach to support fish uses. The material should be removed and measures to prevent additional dumping should be incorporated into the Project.

4.2.13 Sand Mining

Evidence of sand mining is apparent within Reach 2B between the Chowchilla Bifurcation Structure and San Mateo Avenue. This results in the presence of deep, unnatural pools in the river channel and large stockpiles of sand adjacent to the river corridor. Sand mining may have adverse effects on riparian vegetation, native and special status species, channel geomorphology, and seepage. It is recommended that these operations be discontinued and that the Project include measures to prevent future mining operations within the Project area. Sand mining does not refer to future sediment management or maintenance dredging that may occur as part of the Project, which would be conducted according to the Sediment Management Plan.

5.0 No-Action Alternative

Consideration of a no-action or no-project alternative is required for NEPA and CEQA. Herein called the No-Action Alternative, evaluation of this alternative would compare existing baseline conditions with the likely future conditions in the Project area without the implementation of the Project. Under the No-Action Alternative, the existing conditions are compared with projected future conditions.

If the Project were not implemented, the components described in this TM would not be implemented; however, other components of the SJRRP would be implemented if they have completed appropriate environmental reviews and have been approved. Likely future conditions include the SJRRP components anticipated to be analyzed at a project level in the PEIS/R for the SJRRP, the Interim Flows analyzed in the Interim Flow Environmental Assessment (SJRRP 2009c), and other reasonably foreseeable actions expected to occur in the study area. It is assumed for the future No-Action condition that agriculture would continue and cropland would be the dominant cover type, consistent with the existing condition.

5.1 Fisheries

In the No-Action Alternative (no channel improvements, reduced level of Restoration Flows), the maximum channel conveyance is limited to the existing capacity (1,300 cfs into Reach 2B). Fish passage would not be provided at structures (Chowchilla Bifurcation Structure, San Mateo Avenue, and Mendota Dam). All Restoration Flows would be routed through the Pool where fish would be exposed to entrainment in the canal intakes and possibly fish and bird predation. Juvenile fish may have a difficult time finding their way out of the Mendota Pool and into Reach 3 past Mendota Dam. Adult salmon have been able move upstream of Mendota Dam in past years when the flashboards were removed during major floods events. During most Restoration Flows with the flashboards in, salmon would not be able to pass upstream of Mendota Dam unless fish passage facilities were added or restored.

5.2 Habitat

Under the No-Action Alternative, habitat conditions in the project area are not likely to change. In this alternative, if Restoration Flows were to enter Reach 2B, the condition of the narrow strips of native riparian vegetation along the channel banks downstream of the San Mateo Avenue crossing would be maintained by the relatively stable water level held by Mendota Dam. Upstream of San Mateo Avenue, riparian vegetation may recruit along the wetted channel banks unless vegetation removal is employed.

5.3 Seepage

The No-Action Alternative (no channel or structural improvements, reduced or rerouted Restoration Flows) would maintain the existing levee alignments and heights and maximum conveyance would continue to be limited to the existing capacity (1,300 cfs). If Restoration Flows enter the existing Reach 2B, there would probably be a minimal increase in seepage from the river channel.

5.4 Land Use, Agriculture, Socioeconomics, and Environmental Justice

Under No-Action conditions, the Project would not be implemented, and future land use in the area is unlikely to change. Reach 2B is in the unincorporated areas of both Fresno and Madera Counties. The nearest incorporated cities are Firebaugh and Mendota, both in Fresno County. Population is expected to increase annually, compounded, by 1.8 percent and 2.5 percent in Fresno and Madera Counties, respectively, between 2000 and 2050 (CDF 2007). Most of that growth would likely occur in areas near the main cities in each of the counties. While population and economic projection data for specific unincorporated subareas of the counties are unavailable, neither agricultural nor non-agricultural activity is likely to expand substantially in the Mendota area.

If the Reach 2B Project is not implemented, future socioeconomic conditions in the pertinent Fresno and Madera County areas relative to conditions in other areas in the two counties would be expected to be similar. It is expected that the Reach 2B area would remain in agriculture and that most of the working population in the area would remain employed in agriculture and related industries.

5.5 Geomorphology

The No-Action Alternative (no channel or structural improvements and reduced or rerouted Restoration Flows) would maintain the existing levee alignments and heights and maximum conveyance would continue to be limited to the existing capacity (1,300 cfs). If Restoration Flows enter the existing Reach 2B sand transport would likely increase; however, recent sediment continuity studies have predicted that sand inputs from Reach 2A will likely result in net deposition in the upper segment of Reach 2B and potentially down to the Mendota Pool. The No-Action Alternative would not likely change the existing geomorphic conditions in Reach 2B.

6.0 Alternatives Formulation Process

As part of implementation of the Settlement, Reclamation and DWR began the NEPA/CEQA process on the site-specific projects, including the Mendota Pool Bypass and Reach 2B Improvements Project, by initiating preparation of an EIS/R. An early step in producing the EIS/R is the formulation of the project alternatives that would be addressed by the document.

6.1 Process Overview

This TM presents initial options for meeting project goals and objectives. Options were developed based on existing information and data, studies undertaken for the PEIS/R process, pre-appraisal level analyses and screening, as well as input from Program Work Groups, stakeholders, and the public. It is anticipated that a public workshop will be conducted to further present and obtain input on the Initial Options presented in this TM. Following this TM, the initial options will be refined based on impact evaluations, additional engineering analyses, additional data collection (as available), screening criteria, and public input.

Refined options will be evaluated using a set of evaluation and screening criteria developed pursuant to NEPA and CEQA requirements, and developed in coordination with project proponents, to produce a range of reasonable alternatives. The evaluation process would leverage ongoing data collection efforts, engineering analyses and modeling, as well as stakeholder and public input.

Using information obtained through option evaluation and refinement, the final set of bypass, channel, and structures modification options would be combined to create preliminary alternatives, which would be the basis for the first draft of the EIS/R project description.

Opportunities for stakeholder involvement are integrated throughout the alternatives formulation process. Figure 6-1 presents a graphical view of the process.

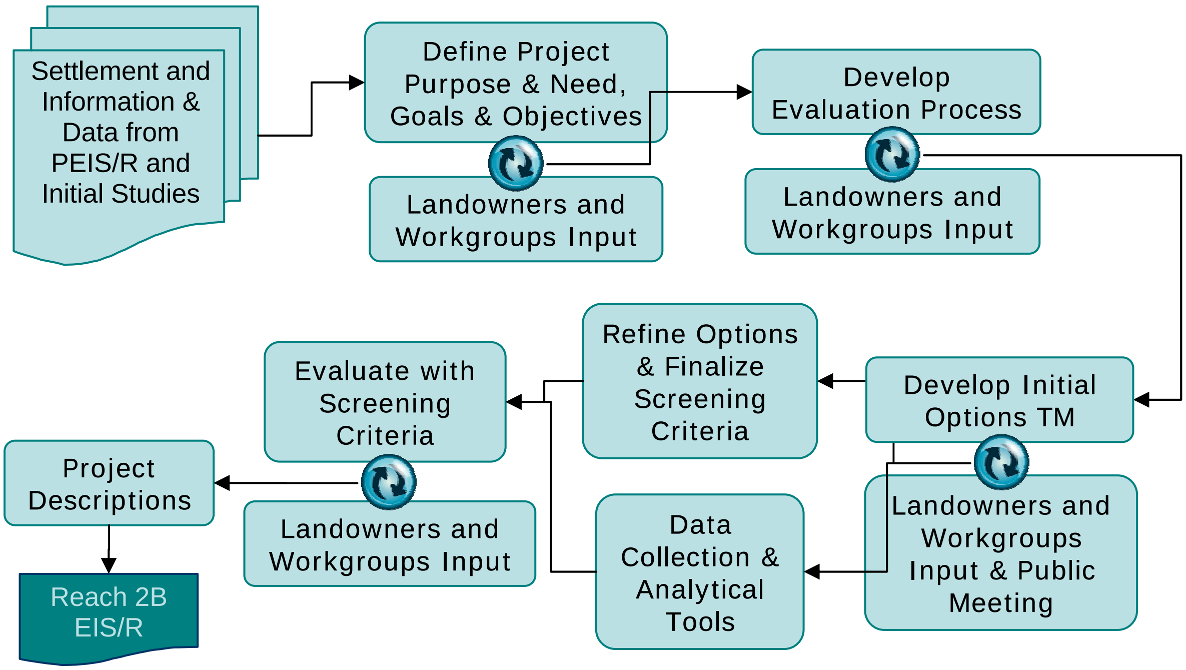


Figure 6-1
Project Alternatives Formulation Process

6.2 Stakeholder Involvement

The initial options development provides the opportunity for early stakeholder involvement and input. Primary stakeholders include Federal, State, and local agencies, landowners, and the public. The following sections describe the level of involvement of the various stakeholder groups in the initial options formulation.

6.2.1 Federal, State, & Local Agencies

Federal and State Implementing Agencies involved in the SJRRP have representatives in the Technical Work Groups and Subgroups. These groups provide support for the development, evaluation, and refinement of concepts. The following groups had input during the preparation of this TM:

- Fisheries Management Work Group (FMWG): DWR presented the initial options for the Reach 2B floodplain and Mendota Pool Bypass alignment at the November 10, 2009 meeting. Refinement of initial options criteria and requirements related to fisheries were discussed during the December 11, 2009 Fisheries/Alternatives Subgroup. In addition, The Group has initiated discussions regarding the design flow for fish screening and will be involved in refining the floodplain options.
- Environmental Compliance and Permitting Work Group: The Reach 2B consultant presented the initial options for the Reach 2B floodplain and Mendota Pool Bypass alignment at the December 1, 2009 meeting.

- Engineering and Design Work Group: Engineering and Design Work Group members developed pre-appraisal level structural options descriptions that addressed channel and floodplain conveyance given the site boundary conditions and a range of potential floodplain and channel characteristics
- Water Management Work Group: The Water Management Work Group developed flow hydrographs. Additionally, the group is coordinating with Reclamation and other stakeholders on Program operational guidelines
- Alternatives Subgroup: Refinement of initial options criteria and requirements related to fisheries were discussed during the December 11, 2009 Fisheries/Alternatives Subgroup meeting

6.2.2 Landowners

Meetings are held periodically with the landowners to provide updates on project status and collect input on alternatives development. The Reach 2B floodplain pre-appraisal level themes and Mendota Pool Bypass alignments were presented by DWR at the November 16, 2009 meeting.

6.2.3 Public

Reclamation and DWR held two public scoping meetings in July of 2009 for the purposes on initiating the NEPA and CEQA processes on the Project. During the scoping meetings and throughout the public comment period, Reclamation and DWR accepted comments on the proposed Project regarding the range of alternatives, the environmental effects, and the mitigation measures to be considered in the EIS/R. Suggestions regarding the pre-appraisal level themes were documented in the Scoping Report and have been considered in this TM.

When they are released for public review, the public would also have the opportunity to comment on the Draft and Final EIS/R documents prepared for the Project. Public meetings would be held following the publication of these documents and a public comment period would be observed.

6.3 Initial Options Formulation

The initial options were formulated based existing information and data, preliminary engineering analyses and screening, as well as input from Program Work Groups, stakeholders, and the public. One of the guiding project objectives and subsequent analyses pertains to flow conveyance. A one-dimensional hydraulic model was completed during the development of initial channel/floodplain options to examine the largest range of practical and feasible floodplain widths given a reasonable range of management and habitat restoration strategies.

The following sources of information were utilized in the initial options formulation:

- Public scoping comments
- SJRRP documents

- Pre-Settlement documents such as the *San Joaquin River Restoration Study Background Document* (McBain & Trush 2002)
- NMFS and DFG guidance on the restoration of salmonid passage (NMFS 2001 and DFG 1998)
- Preliminary pre-appraisal analyses prepared by DWR
- Technical expertise of the Implementing Agencies
- Initial screening involved reviewing the options for consistency with the Settlement requirements and for technical feasibility. Any option deemed technically infeasible or beyond to the scope of the Settlement or contrary to its requirements were not carried forward for further consideration (see Section 6.4).

6.4 Concepts Considered and Eliminated from Further Consideration

Some actions suggested during the scoping process and considered by the Project Team were not retained for inclusion in the Project initial options because they would not meet the project purposes, needs, goals, and objectives. These actions, and associated screening information, are summarized below.

- Mitigation for flood impacts: No alterations to flood management operations are included in the Project, and mitigation for flood impacts not associated with the Project are unwarranted. Local flooding conditions would be improved through increased capacity within the channel and floodplain and improved levees.
- Evaluation and redesign of the Columbia-Mowry Distribution System including facility access, O&M, pumps, pipelines, and power: Modifications to existing canals, pumps, pipelines, access, and power are limited to those relocations necessary to construct the Project. The Project will not include evaluation or redesign of system components outside of those potentially impacted by the Project.
- No interruption of water deliveries: The Project goals and objectives do include accommodating water deliveries up to 2,500 cfs within Reach 2B; however, the ability of Reclamation to perform in delivering the contracted water amounts is outside the Project purpose.
- Acquire land to support recreation, tourism, flora, fauna, and groundwater recharge: The purpose of the Project does not include independently supporting recreation, tourism, flora (other than riparian habitat), fauna (other than salmon), or groundwater recharge, so land would not be acquired solely for these purposes. However, opportunities may exist to support these functions in conjunction or incidental to implementation of the Project, and land acquired to meet the Project purposes, needs, goals, and objectives may also benefit recreation, tourism, flora, fauna, and groundwater recharge.
- Shortening channel distance to reduce levee length and reduce maintenance costs: Shortening of the river channel or the bypass alignments is currently not

considered due to the considerable negative effects to habitat, geomorphology, and sediment continuity in the reach that would result from shortening, or straightening, the channel.

- Installing a cutoff channel before the river bends just downstream of the Chowchilla Bifurcation Structure to reduce flooding toward Hwy 180: No alterations to flood management operations are included in the Project, and mitigation for flood impacts not associated with the Project are unwarranted. Local flooding conditions could be improved through increased capacity within the channel and floodplain and improved levees.
- Installing a wall across the river in Reach 3 just below Mendota Dam and diverting water to Mendota Pool: This action would not meet the purpose and need of the Settlement as it would not provide a bypass around the Pool.
- Allow salmon in the Pool and Chowchilla Bypass: The extent to which fish would be screened out of the Pool and Chowchilla Bypass has not been determined at this time. Fish screening, and any benefits that may be provided under future conditions, would be considered in the alternatives evaluation process.
- Include provisions to allow for Mendota Dam maintenance: Construction of the Bypass places maintenance of Mendota Dam outside the purpose, need, and scope of this project.
- Avoid bifurcation of future flows: The Settlement requires Restoration Flows in Reach 2B and in downstream reaches, but it does not require flood conveyance in Reach 2B, and diversion of flood flows into the Chowchilla Bypass is required to meet existing flood operation guidelines. The flexibility to divert flows away from the Bypass and to the Pool is also required to meet potential Exchange Contract water deliveries; however, Restoration Flows are required in the Mendota Pool Bypass and downstream reaches.
- Fish screens in the Pool: This action would not meet the purpose and need of the Settlement as it would not provide a bypass around the Pool. In addition, the maintenance, cost and reliability of fish screens for all Pool connections would be problematic.
- Evaluate all alternatives that avoid impacts to wetlands: The extent to which initial options impact existing wetlands has not been determined at this time. Extent of impact to existing wetlands would be considered in the alternatives evaluation process.
- Avoid dredging or filling in waters of the United States: Filling in waters of the United States would be minimized to the extent possible and would be considered in the alternatives evaluation process.
- Address effects of the Project on Milburn Pond: Addressing the effects of the Project on Milburn Pond is outside of the purpose, need, and scope of this project.
- Do not reintroduce salmon in order to protect existing riparian habitat: Existing riparian habitat would be considered in the alternatives evaluation process. Not reintroducing salmon would be contrary to the Settlement.

Some additional options exist that were not part of the scoping process, but were also considered by the Project Team and not retained for inclusion in the Project options because they would not meet the project purposes, needs, goals, and objectives. These include the following:

- Adding a separate facility to facilitate fish passage at the Chowchilla Bifurcation Structure: Eliminated due to the complexity and anticipated cost of this option compared with modifying the existing structure.
- Construction of levees to withstand a 200-year flood: Eliminated because existing levees in the Project area are not part of the Lower San Joaquin River Flood Control Project.
- Behavioral fish barriers: Eliminated because behavioral fish barrier efficiencies rarely exceed 60 percent , while physical barriers can be up to 95 percent effective (NMFS 2008). Also, the flow routing constraints at the Mendota Pool Bypass Fish Screen (e.g. the potential for significantly higher flows routed to Mendota Pool versus the Bypass) may make behavioral barriers non-functional.

7.0 Initial Project Options

This chapter presents the initial options developed for the Project. Options are presented for each Project component individually. As the alternatives development progresses, individual options for each component may be combined together to form comprehensive Project alternatives. For example, a Project alternative would include a selected option from each of the channel, floodplain, bypass, and structure components described below. Factors that will influence the selection of options include whether they comply with the terms of the Settlement and whether they meet the Project goals and objectives. Project alternatives will then be evaluated according to their relative costs, benefits, and impacts.

7.1 Channel and Floodplain Options

The following describes the options under consideration for the channel and floodplain for the Reach 2B and Mendota Pool Bypass components of the Project.

7.1.1 Reach 2B Channel

Conditions in the channel are important for meeting flow conveyance, water supply, fish habitat and passage, habitat restoration, and geomorphology goals and objectives. To offer a range of potential main river channel conditions amongst the channel Options, channel roughness was used as a surrogate for other parameters that relate directly to the goals and objectives. For example, channel roughness will affect the capacity of the channel (flow conveyance goal), sediment transport conditions (geomorphology goals), and potential fish habitat features (fish habitat and passage goals). Channel Options vary over the range from most rough to moderately rough to least rough and are described in terms of differing levels of channel excavation and vegetation removal. It should be noted that while Option roughness is described in terms of excavation and vegetation, channel roughness also includes elements such as woody debris and bed features and complexity. Specific physical alterations to the channel presented in each Option are summarized in Table 7-1.

Table 7-1
Reach 2B Channel Options

Option ID	Description
R2B-1	No physical changes to the main river channel.
R2B-2	No excavation in the main river channel. Vegetation removal.
R2B-3	Some excavation in the main river channel to increase capacity. Vegetation removal.

R2B-1 (no physical changes)

Under this option no physical changes would be made to the channel. There would be no excavation and no vegetation removal, and this Option would allow for the establishment of additional woody vegetation in the channel or along the channel margins. This Option represents the roughest channel condition of the range of Options presented. Currently, this option is combined with Options FP-3 and FP-4 for the purposes of the hydraulic modeling (see Section 7.1.2)

Construction
No construction activities are associated with this option.

Operation & Maintenance
Operation and maintenance for this option is considered to be similar to the existing condition, but is also dependent on the sediment continuity of the channel and floodplain system as a whole. Since the reach is expected to be a depositional reach, some future dredging may be necessary in accordance with the SJRRP Sediment Management Plan. However, since Option R2B-1 is paired with floodplain Options FP-3 and FP-4, which are wide and may include sufficient width for the channel to self-maintain its capacity, maintenance dredging is not currently expected to be frequent or significant. Additionally, vegetation maintenance in the channel is not expected.

Cost
No construction activities are associated with this option.

Hydrologic/Hydraulic Modification
No hydrologic/hydraulic modification is associated with this option.

Fish Suitability
This option provides potentially suitable habitat for fish. It leaves existing vegetation intact, and allows for the development of additional riparian vegetation in and along the existing channel. Some portions of the existing channel may develop into floodplain habitat depending on the frequency and duration of the various future flows. In-channel habitat would primarily be defined by pool and bar development, which is influenced by channel scour and vegetation.

R2B-2 (vegetation removal and no excavation)
Under this option no excavation and/or reconfiguration of the channel would occur; however, unlike Option R2B-1, this Option includes removal of all woody vegetation within the levee alignments, which includes the channel. The channel would be permanently maintained to prevent the reestablishment of woody vegetation. This Option represents a moderately rough channel condition of the range of Options presented. Currently, this option is combined with Option FP-2 for the purposes of the hydraulic modeling (see Section 7.1.2).

Construction
Construction of this option involves dewatering of the inundated portions of the proposed vegetation removal areas, if necessary, and removal of woody vegetation in and along the channel. Obtaining the necessary permits (Rivers and Harbors Act Section 10 permit for work in navigable waters, Clean Water Act Section 404 permit for dredge/fill in waters of the United States, including wetlands, Clean Water Act Section 401 water quality certification, California Fish and Game Code Section 1600 streambed alteration

agreement, etc.) and providing the required mitigation associated with existing habitat impacts may make this option schedule and cost prohibitive.

Operation & Maintenance
Operation and maintenance is expected to be significant and ongoing for this option because maintenance would be required to prevent reestablishment of vegetation. Continued vegetation removal in the river channel and corridor may be destabilizing to the channel morphology and may negatively affect the habitats that the Project is intended to restore.

Cost
Cost of the option could be significant considering the mitigation requirements and the maintenance costs associated with continued vegetation removal that would be required.

Hydrologic/Hydraulic Modification
This option is intended to provide additional capacity in the river channel; thus it is expected to reduce flood stage for certain flows.

Fish Suitability
This Option may negatively affect fisheries habitats within the channel and floodplain since no woody vegetation would be allowed to establish and, consequently, in-channel habitat would likely remain poor. Floodplain habitat would be provided (as part of Option FP-2), but since woody vegetation would be removed, the floodplain features important to fish would take a long time to develop or would be transitory.

R2B-3 (vegetation removal with some excavation)
Under this option some excavation and/or reconfiguration would be conducted within the channel to increase channel capacity. The quantity and locations of earthwork activities have not been estimated at this time. This option also includes removal of all existing woody vegetation, which includes the channel. The channel would be permanently maintained to prevent the reestablishment of woody vegetation. This Option represents the least rough channel condition of the range of Options presented. Currently, this option is combined with Option FP-1 for the purposes of the hydraulic modeling (see Section 7.1.2).

Construction
Construction of this option involves excavating primarily sandy material from the channel bottom and removal of woody vegetation in and along the channel. Options for the excavation include dewatering the inundated portions of the proposed excavation areas and conducting the excavation in the dry, performing the excavation during a period when the channel is already drained (such as during Mendota Dam maintenance), or performing the excavation in the wet. Obtaining the necessary permits (Rivers and Harbors Act Section 10 permit for work in navigable waters, Clean Water Act Section 404 permit for dredge/fill in waters of the United States, including wetlands, Clean Water Act Section 401 water quality certification, California Fish and Game Code Section 1600 streambed alteration agreement, etc.) and providing the required mitigation associated with existing habitat impacts may make this option schedule and cost prohibitive.

Operation & Maintenance
Operation and maintenance is expected to be significant and ongoing for this option because (1) maintenance would be required to prevent reestablishment of vegetation, and (2) Reach 2B is expected to be a depositional reach which would require dredging to maintain the capacity of the excavated channel. Continued excavation in the river channel and corridor may be damaging to the habitats that the Project is intended to restore.

Cost
Cost of the option could be significant considering the continued vegetation and dredging maintenance that would be required.

Hydrologic/Hydraulic Modification
This option is intended to provide additional capacity in the river channel; thus it is expected to reduce flood stage for certain flows.

Fish Suitability
This option may negatively affect fisheries habitats within the channel and floodplain since no woody vegetation would be allowed to establish and, consequently, in-channel habitat would likely remain poor. Minimal floodplain habitat would be provided (as part of Option FP-1), but since woody vegetation would be removed, the floodplain features important to fish would take a long time to develop or would be transitory.

7.1.2 Reach 2B Floodplain

Floodplain options along Reach 2B cover a range of floodplain widths based on varying floodplain depths and floodplain roughness characteristics (see Table 7-2 and Figure 7-1). Conditions on the floodplain are important for meeting flow conveyance, water supply, fish habitat and passage, habitat restoration, and geomorphology goals and objectives. To offer a range of potential floodplain conditions amongst the floodplain Options, floodplain roughness was used as a surrogate for other parameters that relate directly to the goals and objectives. For example, floodplain roughness will affect the capacity of the floodplain (flow conveyance goal), sediment transport conditions (geomorphology goals), potential fish habitat features (fish habitat and passage goals), and riparian habitat conditions (habitat restoration goals). Floodplain Options vary over the range from most rough to moderately rough to least rough and are described in terms of differing types and combinations of vegetation. It should be noted that while Option roughness is described in terms of vegetation, floodplain roughness also includes elements such as side channels, woody debris, irregular grading, habitat features and complexity.

Options include the raising of existing levees and/or construction of new levees to convey Restoration Flows and provide adequate freeboard. Options FP-1 and FP-2 also include vegetation removal to achieve the desired floodplain roughness and associated increased capacity.

The modeling used to estimate the range of floodplain widths presented as floodplain Options FP-2, FP-3, and FP-4 assumed a range of vegetation types (or floodplain roughness) together with an average 18 inch depth of flow on the floodplain at 4,000 cfs. This was done to qualify the width of the corridor between the levees as sufficient to provide floodplain inundation without being too deep so as to overtop certain vegetation types (e.g. grasses). In practice, due to the topographic fluctuations that exist in the proposed floodplain areas, in addition to the potential for proposed graded habitat features within the floodplains, they will function at a range of flows and exhibit a range of inundation depths. The ranges of floodplain depths and widths will be more clearly understood through coordination with the FMWG concerning applicable floodplain rearing habitat, coupled with additional modeling to be conducted as part of the alternatives evaluation process.

Given the mobile and loose substrate in the reach, the system is expected to develop into a multi-staged channel (various floodplain benches at various flow depths and return frequencies) over time and through natural geomorphic processes. Terracing the floodplain through grading and direct manipulation may be considered if modeling shows that the system would likely function in perpetual disequilibrium (i.e. unable to achieve a dynamic equilibrium). However, the impacts to existing vegetation and habitats resulting from grading are potentially significant and would need to be considered. The benefits and effects of floodplain terracing will be considered during the alternatives evaluation process.

The options presented provide levee heights capable of conveying 4,500 cfs with 3 feet of freeboard. As the alternatives formulation process progresses, the Project may consider conveying up to 7,000 cfs in Reach 2B from the Chowchilla Bifurcation Structure to the Mendota Pool Bypass Bifurcation Structure. To accommodate the additional capacity, levee heights would be increased over what is presented herein, but additional floodplain width is not currently anticipated.

Table 7-2
Reach 2B Floodplain Options

Option ID	Description
FP-1	Maintain the existing levee alignments, remove existing woody vegetation, and manage to prevent reestablishment of woody vegetation.
FP-2	New levee alignments with 880-foot-wide corridor, remove existing woody vegetation, and manage to prevent reestablishment of woody vegetation.
FP-3	New levee alignments with 1,660-foot-wide corridor, maintain existing woody vegetation, and manage to prevent establishment of woody vegetation in new areas.
FP-4	New levee alignments with 3,770-foot-wide corridor, maintain existing woody vegetation, and allow establishment of woody vegetation in new areas.

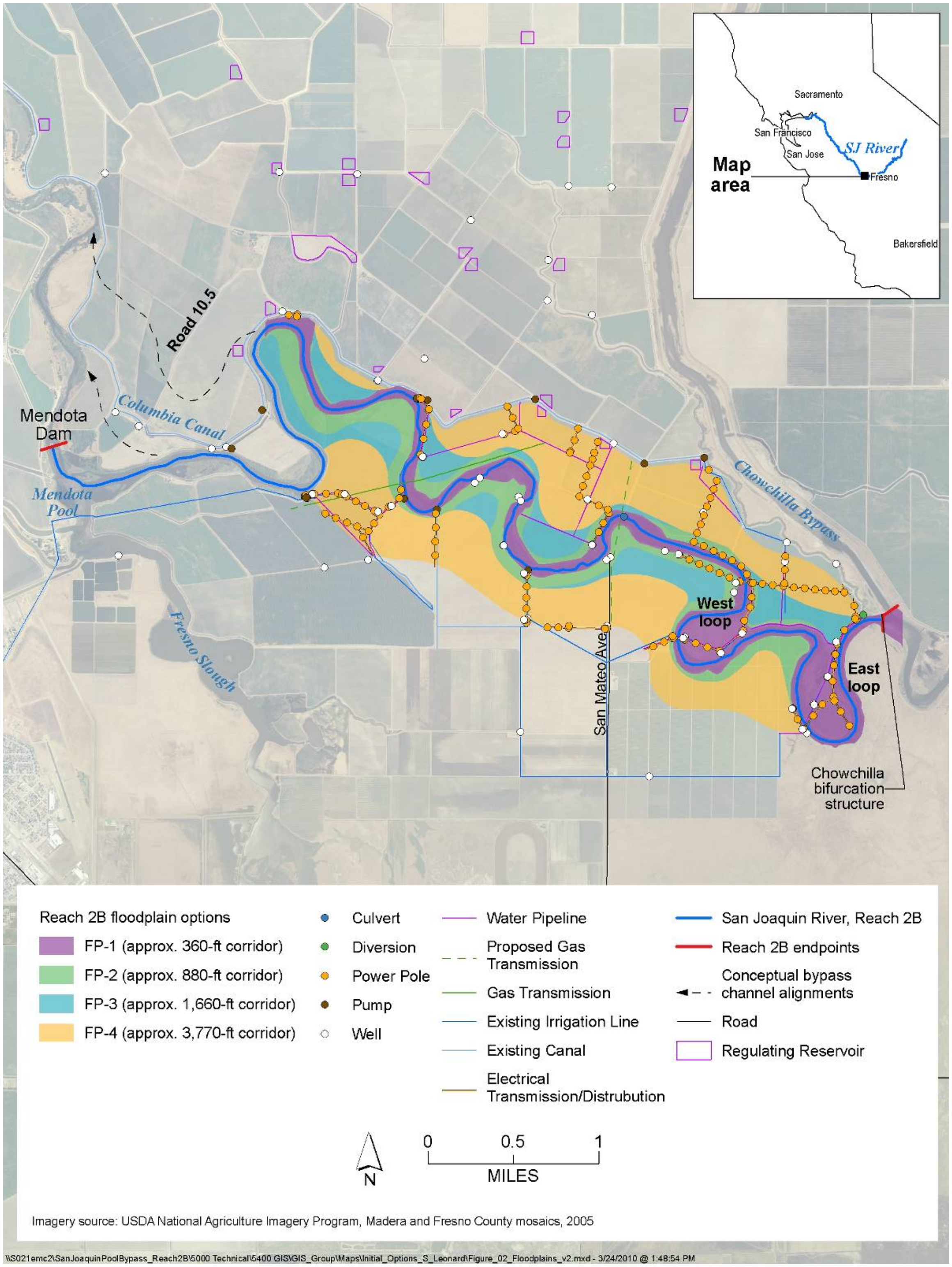


Figure 7-1
Reach 2B Floodplain Options

FP-1 (existing levee alignments)

In this option, the current levee alignments would be maintained. Levee heights would be increased to accommodate 4,500 cfs and 3 feet of freeboard within the existing alignments. Specifically, this Option would either raise the existing levees or construct new levees. Construction of the new levees would occur directly adjacent to and outside of the existing levees, and approximately 65 acres of private land would need to be acquired. Existing levees would be removed following the construction of the new levees to prevent fish stranding. Replacement of the existing levees would be to adequately address seepage and stability issues.

New left and right levee lengths are estimated to be approximately 9 and 6 miles, respectively. The proposed levee heights are estimated to range from 4 to 10 feet, and some portions of the levees are expected to need modification to address seepage issues. Ongoing geotechnical investigations and analyses will provide additional information concerning the necessity for slurry walls.

Table 7-3
FP-1 Levees, Relocations, and Land Acquisition

	Left Levee	Right Levee
Levee Length	9 miles	6 miles
Levee Height	4-10 feet	4-10 feet
Canal Relocations	21,500 linear feet	
Utility Relocations	16,500 linear feet	
Well Relocations	16 wells	
Land Acquisition	65 acres	

Option FP-1 would also include removal of all woody vegetation within the levee alignments, including the floodplain, for the purposes of creating sufficient channel capacity and limiting channel roughness (reach average Manning's n value of 0.055). Vegetation would be permanently maintained to prevent the reestablishment of woody vegetation. Grasses would be allowed to establish within the levee alignments. Floodplain habitats would be limited to grassed floodplains throughout the reach. In-channel habitat would be minimal.

Based on preliminary estimates using aerial photographs, Option FP-1 includes approximately 21,500 linear feet of canal relocations, 16,500 linear feet of utility relocations, four pump station relocations, and floodproofing on 16 groundwater wells.

Construction

Construction of this option primarily involves either raising the existing levees or building new levees sized for the 4,500 cfs plus 3 feet of freeboard just outside the existing levees, and subsequent removal of existing levees. In addition, all existing woody vegetation would be cleared and grubbed from the corridor. Existing infrastructure relocations and improvements, such as canal and pump station relocations, would require localized construction activities.

Operation & Maintenance

Primary ongoing maintenance associated with this option involves preventing the establishment of woody vegetation within the corridor. Levees would also require periodic maintenance and repairs. Levee scour could be an issue due to the lack of erosion control associated with woody vegetation and due to the narrow corridor and limits on channel migration.

Cost

Option FP-1 is expected to have the very high capital and operation and maintenance costs due to: the lengths and heights of the levees, the amount of seepage protection required, and the lack of stabilizing vegetation in a sandy substrate channel. In addition, mitigation costs are expected to be very high due to the removal of all existing vegetation, impacts to special status species, and lack of on-site mitigation potential.

Habitat Restoration Potential

The habitat restoration potential of this option is minimal because the riparian functions and values of the proposed managed herbaceous habitat would be far short of the functions and values exhibited by the current woody riparian habitat. Option FP-1 would completely eliminate the existing woody riparian habitat.

Woody riparian habitats serve as transitional areas (ecotones) to upland habitats. They interact in many ways with the channel and bear strongly on the structure and function of the entire aquatic ecosystem. The most important riparian functions that would be lost with the removal of woody riparian vegetation are these:

1. Habitat for numerous species, including juvenile salmonids.

2. Shading and control of the amount of light that reaches the water surface, which in turn affects stream temperatures and productivity

3. Maintenance of stream bank cohesion

4. Source of invertebrate fall (i.e., falling terrestrial insects providing food for fish)

5. Source of organic litter, an important food source for numerous aquatic species

6. Buffer of impacts on the river from nutrients and chemicals from adjacent uplands

7. Source of large woody debris, which in turn perform many other riparian functions

As stated in item 3 above, reduction of woody riparian vegetation can cause decreased stream bank stability, increased channel width and decreased channel depth. The result can be widening and braiding of the low flow channel, loss of channel structure and fish habitat, and subsurface flow during the summer low-flow season. In a recent study at the J. Amorocho Hydraulics Laboratory at UC Davis Large Flume (Kavvas and others 2009), multiple depths and velocities of flows were tested on four species of flexible stem riparian plants and for bare soil. Their results indicate that flexible woody riparian vegetation can be quite beneficial to floodway designs in terms of erosion, scour and channel roughness.

Permanent management of floodplain vegetation in order to prevent re-establishment of woody riparian vegetation typically consists of mowing, herbicide spraying, burning and intensive grazing (goats or sheep). Managed herbaceous vegetation usually becomes dominated by invasive exotic annual grasses and non-native forbs (D'Antonio, 1992). Because of their seasonal nature, exotic annual grasses do not provide significant bank erosion protection which would otherwise be provided by native riparian scrub, woodland or forest (Pers. comm. Jeff Heart, PhD 2008). Substantial bank erosion may decrease the water quality and increase channel incision. The life history of annual grasses consists of quick spring growth and prolific production of seed in late spring or early summer. The grasses die in late summer, and the dead roots may not be capable of providing substantial soil reinforcement to the riverbanks in preparation for heavy fall and winter flows.

The environmental impact of removal of all woody vegetation within the levee alignments would be destructive to existing fish, wildlife, water quality, and vegetation in the reach, thereby triggering mitigation requirements. Typically, natural resource agencies would require a 2:1 or higher mitigation ratio for permanently impacted riparian areas, depending on the quality and extent of their original riparian functions and values, and a 5:1 minimum re-planting mitigation ratio for each riparian tree removed. The extensive cost associated with mitigation for this option would likely far exceed the cost of in-situ riparian habitat enhancement and restoration.

Hydrologic/Hydraulic Modification

Due to the increased capacity and maintained corridor width, water surface elevations associated with the design maximum flow of 4,500 cfs are expected to be higher than current water surface elevations associated with the current reach capacity of 1,300 cfs. This could have a negative effect on seepage and would likely require additional seepage protection compared to other floodplain options.

Fish Suitability

Option FP-1 proposes new levees and vegetation clearing to achieve a capacity of 4,500 cfs within the levee alignments. The existing river corridor is approximately 510 acres between the levees. The channel and floodplain area is narrow and very limited in conveying flood flows. Vegetation clearing would be necessary to maintain capacity, and this greatly diminishes the value of the floodplain and channel habitat for fish. In-channel habitat would be constrained if sediment transport rates are high and the bed is unstable. This could create challenges for fish passage through the Reach 2B channel during low flows.

Floodplain vegetation would also be limited to grasses, which would provide less shading and cover for fish and may increase predation. The lack of woody vegetation would reduce the availability of woody debris and exhibit lower invertebrate and fish productivity than floodplains with woody vegetation (Naiman 2002). The effects of floodplain vegetation on fisheries will be further evaluated by the FMWG fisheries modeling.

Geomorphology

Due to the limited width between levees, no floodplain access, and lack of vegetation, Option FP-1 does not promote in-stream geomorphic processes or morphology. As flows are increased and vegetation is cleared, the channel would become an overwidened conveyance for water and sediment, potentially requiring regular channel dredging and maintenance. The channel would become scoured and uniform. Additionally, Option FP-1 restricts the river's natural meander migration processes by locking the channel in its current location and significantly limiting pool or bar formation.

FP-2 (880-foot corridor)

Option FP-2 includes the same existing channel modifications as Option FP-1, but expands the floodplain width to approximately 880 feet in order to reduce the floodplain depth at 4,000 cfs.

Option FP-2 would also include removal of all woody vegetation within the levee alignments, including the floodplain, for the purposes of creating sufficient channel capacity and limiting channel roughness (reach average Manning's n value of 0.055). Vegetation would be permanently maintained to prevent the reestablishment of woody vegetation. Grasses would be allowed to establish within the levee alignments. Floodplain habitats would be limited to grassed floodplains throughout the reach. In-channel habitat would be minimal.

Levee heights would be designed to accommodate 4,500 cfs and 3 feet of freeboard within the proposed levee alignments. Construction of the new levees would occur outside of the existing levee alignments, and approximately 390 acres of private land would need to be acquired. Existing levees would be removed following the construction of the new levees to prevent fish stranding.

New left and right levee lengths are estimated to be approximately 6 and 6 miles, respectively. Proposed levee heights are estimated to range from 4 to 8 feet, and some portions of the levees are expected to need modification to address seepage issues. Ongoing geotechnical investigations and analyses will provide additional information concerning the necessity for slurry walls.

Based on preliminary estimates using aerial photographs, Option FP-2 includes approximately 24,000 linear feet of canal relocations, 19,500 linear feet of utility relocations, four pump station relocations, and floodproofing on 17 groundwater wells.

Table 7-4
FP-2 Levees, Relocations, and Land Acquisition

	Left Levee	Right Levee
Levee Length	6 miles	6 miles
Levee Height	4-8 feet	4-8 feet
Canal Relocations	24,000 linear feet	
Utility Relocations	19,500 linear feet	
Well Relocations	17 wells	
Land Acquisition	390 acres	

Construction

Construction of this option primarily involves building new levees sized for the 4,500 cfs plus 3 feet of freeboard along an approximate 880 foot wide corridor, and subsequent removal of existing levees. In addition, all existing woody vegetation would be removed and selective earthwork activities would be required within the proposed floodplain. Existing infrastructure relocations and improvements, such as canal and pump station relocations, would require localized construction activities.

Operation & Maintenance

Primary maintenance associated with this option involves preventing the establishment of woody vegetation within the corridor. Levees would also require periodic maintenance and repairs. Levee scour could be an issue due to the lack of erosion control associated with woody vegetation, and due to the narrow corridor and limits on channel migration.

Cost

Capital costs associated with Option FP-2 are expected to be somewhat less than Option FP-1 due to the shorter levee lengths and heights, but operation and maintenance costs are expected to be similar to, or slightly higher than, Option FP-1 due to the expanded floodplain area requiring continued vegetation removal and erosion repair. The magnitude of mitigation costs associated with existing vegetation and habitat to be removed would be similar in magnitude to Option FP-1.

Habitat Restoration Potential

The habitat restoration potential of this option is minimal and is similar to Option FP-1. Also similar to Option FP-1, the environmental impact of woody vegetation removal would impact existing fish, wildlife, water quality, and vegetation in the reach, and the associated slope instability would result in increased erosion potential.

Widening of the floodplain corridor would be somewhat beneficial because it would help buffer the effects of agricultural activities outside of the levees to water quality and aquatic wildlife.

Hydrologic/Hydraulic Modification

The active flow area is spread over a much larger wetted perimeter compared to Option FP-1, providing lower velocities within the floodplain area, and lower overall water surface elevations.

Fish Suitability

Option FP-2 provides for a wider floodplain with setback levees. Vegetation would still be cleared to achieve full conveyance capacity, and functional floodplain habitat would still be impaired due to lack of perennial vegetation. Option FP-2 may allow for the reestablishment of an active channel with river features that may provide some habitat useful for juvenile salmonids. Since vegetation would not be allowed to establish, streambanks would be unstable and channel habitat features would also likely not be persistent.

Floodplain vegetation would also be limited to grasses, which would provide less shading and cover for fish and may increase predation. The lack of woody vegetation would reduce the availability of woody debris and exhibit lower invertebrate and fish productivity than floodplains with woody vegetation (Naiman 2002). The effects of floodplain vegetation on fisheries will be further evaluated by the FMWG fisheries modeling.

Geomorphology

Option FP-2 adds floodplain area and provides for channel-floodplain interaction. However, the width is likely restrictive of channel processes, and vegetation must be cleared to achieve full capacity. Option FP-2 may allow for the reestablishment of an active channel with some pool and bar formation. However, without vegetation, channel erosion and maintenance will likely become an issue. Additionally, Option FP-2 restricts the river’s natural meander migration processes. While providing somewhat more room than Option FP-1, it continues to limit the river’s natural process and function.

FP-3 (1,660-foot corridor)

In this option, the floodplain would be widened to an average width of 1,660 feet to accommodate a moderate floodplain roughness (reach average Manning’s n value of approximately 0.085). The primary differences from Option FP-2 are:

1. Protection of existing vegetation within the channel,

2. Increased roughness associated with woody riparian vegetation within and directly adjacent to the channel, and

3. The resulting increased floodplain width needed to accommodate the Restoration Flows.

Existing vegetation within the existing levee alignments would remain, and the option would allow for establishment of a forest riparian ribbon (approximately 100 to 150 feet wide on each side) directly adjacent to the river channel. However, proposed floodplain areas between the riparian ribbon and proposed levee alignments would include removal of woody vegetation, and these areas would be permanently maintained to prevent the establishment of woody vegetation.

Typical habitats would include a narrow woody riparian ribbon adjacent to the channel and along the banks, and the remainder of the floodplain habitat outside the riparian ribbon would typically be limited to grassed floodplains. The opportunity exists to distribute the grassed and woody habitats in multiple configurations on the floodplain to create more heterogeneous habitat mosaics; however, it should be noted that in order to maintain the design corridor roughness reach-wide, the habitats will primarily consist of grassed floodplains (approximately 70 percent of floodplain acreage).

Levee heights would be designed to accommodate 4,500 cfs and 3 feet of freeboard within the proposed alignments. Construction of the new levees would occur outside of the existing levee alignments, and approximately 850 acres of private land would need to be acquired. Existing levees would be removed following the construction of the new levees to prevent fish stranding.

New left and right levee lengths are estimated to be approximately 5 and 4 miles, respectively. Proposed levee heights are estimated to average 5 feet, and some portion of the levees are expected to need modification to address seepage issues. Ongoing geotechnical investigations and analyses will provide additional information concerning the necessity for slurry walls.

Table 7-5
FP-3 Levees, Relocations, and Land Acquisition

	Left Levee	Right Levee
Levee Length	5 miles	4 miles
Levee Height	5 feet	5 feet
Canal Relocations	26,000 linear feet	
Utility Relocations	20,500 linear feet	
Well Relocations	17 wells	
Land Acquisition	850 acres	

Based on preliminary estimates using aerial photographs, Option FP-3 includes approximately 26,000 linear feet of canal relocations, 20,500 linear feet of utility relocations, four pump station relocations, and floodproofing on 17 groundwater wells.

Construction

Construction of this option primarily involves building new levees along an approximate 1,660 foot wide corridor and potentially removing the old levees. Selective earthwork activities would be required within the proposed floodplain. In addition, revegetation and associated temporary irrigation within the expanded floodplain would be required to support native herbaceous vegetation establishment. Existing infrastructure relocations and improvements, such as canal and pump station relocations, would require localized construction activities.

Operation & Maintenance

Primary ongoing maintenance associated with this option involves preventing the establishment of woody vegetation between the existing vegetation and the new levees. Levees would also require periodic maintenance and repairs. Levee scour could be an issue due to the lack of erosion control that would be provided by woody vegetation on the new floodplain and levees.

Cost

Capital costs associated with Option FP-3 are expected to be similar in magnitude to Option FP-1. Although significantly less levee construction is involved, land acquisition and floodplain earthwork and revegetation costs bring the overall capital costs to a similar level. The magnitude of mitigation costs associated with existing vegetation and habitat to be removed would be significantly lower than Options FP-1 and FP-2, since the existing channel vegetation would be protected in place. However, some existing vegetation would no longer be inundated by the Pool and, as a result, may die back; therefore, conversion of habitat may need to be considered when evaluating mitigation needs.

Habitat Restoration Potential

The habitat restoration potential of Option FP-3 is substantially higher than Options FP-1 and FP-2 because existing riparian vegetation would be preserved and protected during construction. Some mitigation would still be necessary because existing levees, which are proposed to be removed under this option, are currently vegetated with native woody riparian species. Since mitigation planting would not be allowed in the managed, “herbaceous only” areas between the existing and new levees, mitigation would need to be provided outside the immediate Project area. To provide mitigation for the removal of the riparian vegetation, additional land, would need to be acquired. Consideration could be given to staged, selective breaching of existing levees and careful grading of the areas adjacent to these levees in order to prevent fish stranding and in order to maximize the preservation of existing vegetation.

Widening of the floodplain corridor would be beneficial for the quality of the riparian habitat in the future, however, maintaining areas between the existing and proposed levees free of woody vegetation could result in erosion of these areas during high flows. As described above, managed herbaceous vegetation typically does not provide sufficient erosion protection and its habitat and forage values are minimal for indigenous fauna.

Hydrologic/Hydraulic Modification

The active flow area is spread over a much larger wetted perimeter compared to Options FP-1 and FP-2, providing lower velocities within the floodplain area.

Fish Suitability

Option FP-3 greatly increases floodplain width such that existing woody vegetation is retained but new woody vegetation is not allowed in the new floodplain area. Option FP-3 would provide for establishment of a low flow channel and maintain habitat adjacent to the existing channel, which would support some salmonid use as well as use by other native fishes. Floodplain and in-channel features would be more suitable to support fish both on the floodplain and in the channel.

Geomorphology

This option adds more floodplain area, provides for channel-floodplain interaction, and assumes grassy vegetation growth on floodplains with woody vegetation next to the main channel. Option FP-3 provides generally unrestricted opportunities for reestablishing river morphology utilizing natural processes. The levee alignments approximate the belt width of the river corridor, which provides improved flood flow conditions and allows unrestricted meander migration.

FP-4 (3,770-foot corridor)

In this option, the floodplain would be widened to an average width of 3,770 feet to accommodate a high floodplain roughness (reach average Manning’s n value of approximately 0.16). The primary differences from Option FP-3 are:

1. Increased roughness associated with unmanaged vegetated floodplain habitat, and
2. The resulting increased floodplain width needed to accommodate the Restoration Flows.

In Option FP-4, existing vegetation within the existing levee alignments would remain. Areas between the existing and proposed levee alignments would not be managed to remove new woody vegetation, allowing additional woody vegetation to establish by either natural processes and regeneration, through planting, or a combination of both.

This Option has sufficient width to include forested riparian habitat throughout the floodplain. This Option also has the greatest opportunity for providing varying habitats in multiple configurations on the floodplain to create more heterogeneous habitat mosaics. Additional habitats to combine with forested riparian could include grassed floodplains, marshes, high flow side channels, and scrub riparian.

Levee heights would be designed to accommodate 4,500 cfs and 3 feet of freeboard within the proposed alignments. Construction of the new levees would occur outside of the existing levee alignments, and approximately 1,950 acres of private land would need to be acquired. Existing levees would be removed following the construction of the new levees to prevent fish stranding.

New left and right levee lengths are estimated to be approximately 5 and 4 miles, respectively. Proposed levee heights are expected to average 5 feet, and some portion of the levees are expected to need modification to address seepage issues. Ongoing geotechnical investigations and analyses will provide additional information concerning the necessity for slurry walls.

Table 7-6
FP-4 Levees, Relocations, and Land Acquisition

	Left Levee	Right Levee
Levee Length	5 miles	4 miles
Levee Height	5 feet	5 feet
Canal Relocations	33,000 linear feet	
Utility Relocations	43,500 linear feet	
Well Relocations	23 wells	
Land Acquisition	1,950 acres	

Based on preliminary estimates using aerial photographs, Option FP-4 includes approximately 33,000 linear feet of canal relocations, 43,500 linear feet of utility relocations, four pump station relocations, and floodproofing on 23 groundwater wells.

Construction

Construction of this option primarily involves building new levees along an approximate 3,770 foot wide corridor and potentially removing the old levees. Selective earthwork activities would be required within the proposed floodplain. In addition, revegetation and associated temporary irrigation within the expanded floodplain would be required to support native vegetation establishment. Existing infrastructure relocations and improvements, such as canal and pump station relocations, would require localized construction activities.

Operation & Maintenance

Primary ongoing maintenance associated with this option involves periodic maintenance and repairs on the new levees. Levee scour is expected to be minimal due to the erosion protection that would be provided by woody vegetation on the new floodplain, the minimal flow depth, and low floodplain velocities.

Cost

Capital costs are expected to be significantly higher than Options FP-1 and FP-3 due to the increased land acquisition and floodplain earthwork and revegetation costs. Operation and maintenance costs are expected to be the least of the four floodplain options. In addition, mitigation costs are expected to be low since the existing channel vegetation would be protected in place. However, some existing vegetation would no longer be inundated by the Pool and, as a result, may die back; therefore, conversion of habitat may need to be considered when evaluating mitigation needs.

Habitat Restoration Potential

Option FP-4 provides the highest habitat restoration potential of the four floodplain options for these reasons:

- It would preserve the existing riparian vegetation
- Areas between the existing and proposed levees would likely be manipulated to some extent to facilitate rearing and other habitat, but would be allowed to naturally regenerate into a potential riparian woodland, forest or scrub. (Close attention would have to be paid to invasive species' management in the naturally revegetating areas for extensive periods of time. Active revegetation would be a substantially more effective and less costly solution in the long run.)

Some mitigation would be still necessary because existing levees proposed to be removed under this option currently exhibit native woody riparian vegetation in places. Unlike the previous three options, this mitigation could be implemented in the immediate Project area between the existing and proposed levees. It is likely that no additional mitigation land would be required. As in Option FP-3, consideration could be given to selective staged breaching of the levees and careful grading of the adjacent areas to prevent fish stranding in order to maximize the preservation of existing vegetation. This approach would additionally minimize the cost of mitigation.

Widening of the floodplain corridor would be extremely beneficial for the quality of the riparian habitat in the future, once native vegetation is established. However, prior to establishment this area would be vulnerable to erosional damage during the first several years of higher flows. The habitat value and erosion resistance of the agricultural fields between levees could be substantially enhanced by planting patches of appropriate types of native vegetation and seeding with a mix of woody and herbaceous native species. Close attention should be paid to selection of species appropriate for a given soil type.

Reach 2B is surrounded by a diverse mosaic of soil types of varying texture, salinity, alkalinity and conductivity.

Hydrologic/Hydraulic Modification

The active flow area is spread over a much larger wetted perimeter compared to the other floodplain options, providing lower velocities within the floodplain area.

Fish Suitability

Option FP-4 provides increased amount of floodplain but would feature a forested or partially forested floodplain instead of vegetated floodplain. This provides at least an equivalent level of benefit as Option FP-3. Any additional value of this floodplain to fish is unknown and would require some additional analysis and consideration.

Geomorphology

Option FP-4 provides similar benefits for reestablishing river morphology through natural processes as Option FP-3.

7.1.3 Mendota Pool Bypass Channel

Options for the Mendota Pool Bypass channel include three different channel alignments (see Table 7-7 and Figure 7-2). Currently, it is assumed that channel cross-section dimensions would be designed to mimic the selected channel cross-section for Reach 2B, and this component of the channel is not addressed at this time.

Table 7-7
Mendota Pool Bypass Channel Options

Option ID	Description
MPB-1	Settlement alignment of the bypass
MPB-2	Compact alignment of the bypass
MPB-3	Relocation of Mendota Dam

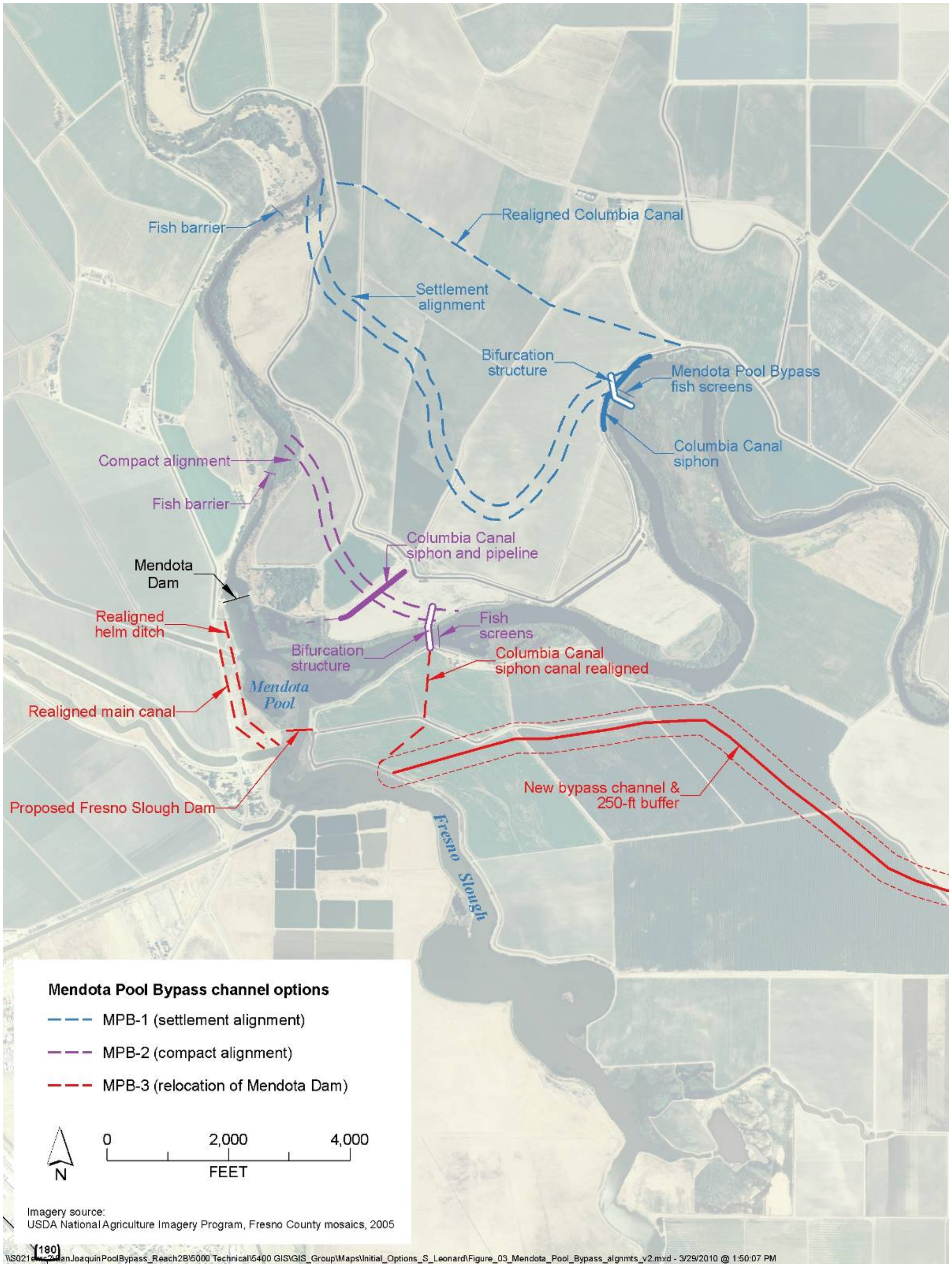


Figure 7-2
Mendota Pool Bypass Channel Options

MPB-1 (Settlement alignment)

This option follows the alignment of the bypass presented in the Settlement documents. The alignment would be approximately 1.9 miles long, and it would connect to Reach 2B approximately 2.8 river miles upstream of Mendota Dam and to Reach 3 approximately 1.5 river miles downstream.

Construction of the bypass would require several structures. A bifurcation/diversion structure would be needed at the upstream end of the bypass to divert flows into the bypass and/or into the Pool, as well as maintain the operating elevation in the Pool. To prevent fish from entering the Pool, fish screens and barriers would be constructed at either end of the bypass. To accommodate the relatively large channel drop from inlet end to outlet end and prevent channel downcutting, a series of drop structures would be constructed within the bypass channel. The alignment crosses the existing Columbia Canal at the upstream end of the bypass and again near the downstream end. To accommodate the Canal's connection to Mendota Pool, a siphon under the upstream end of the Bypass would be constructed along the existing Canal, and to maintain connection to the Canal outside the Project area, a portion of the Canal would be realigned to the north. The alignment also crosses Road 10 ½, and a crossing may be required. See Section 7.2 for a discussion of the options under consideration for each structure.

Option MPB-1 is expected to also include canal relocations, utility relocations, pump station relocations, and floodproofing of groundwater wells, but these have not been quantified at this time.

The infrastructure that would be required for this option includes the following:

- Mendota Pool Bypass bifurcation/diversion structure
- Mendota Pool Bypass fish screens (upstream end)
- Mendota Pool Bypass fish barriers (downstream end)
- Mendota Pool Bypass drop structures
- Columbia Canal siphon
- Columbia Canal realignment
- Road 10 ½ crossing

Construction

Construction of this option would involve excavating a new channel through existing farm fields, construction of levees to protect the adjacent lands, and several infrastructure modifications to accommodate the new alignment. In addition, because the option effectively shortens the channel length of the river, which in turn steepens the overall gradient of the bypass compared to the existing river, drop structures would be incorporated in the bypass channel.

Operation & Maintenance

Operation and maintenance of this option would involve periodic maintenance and repairs on the levees, fish screens and barriers, bifurcation structure, drop structures, and crossing.

Cost

While the levee alignments for Option MPB-2 are shorter than those for MPB-1 and channel excavation less, the capital costs for Option MPB-1 are estimated to be comparable to Option MPB-2 due to increased costs of infrastructure relocations and the addition of the Columbia Canal pipeline.

Hydrologic/Hydraulic Modification

In-stream hydrologic and hydraulic modifications are expected to be primarily related to the width of the floodplain (see Section 7.1.4) and the design of the drop structures (see Section 7.2.7). Seepage and drainage impacts will be addressed as part of the design.

Fish Suitability

Meeting criteria for fish passage should not be an issue in this alignment as long as drop structures are sized and installed at the correct elevation to pass upstream juvenile salmonids. If the criteria are met, the structures should meet the needs of native fish species as well. All structures associated with the alignment would be designed for the fish passage needs of the reach. Fish habitat in the bypass channel itself is contingent upon channel design.

Geomorphology

Option MPB-1 provides the some opportunity to accommodate natural-process channel morphology, outside of the drop structure area, because the alignment incorporates three meander bends, which affect the development of point bars and varied bed surface features.

MPB-2 (compact alignment)

This alignment option represents a compact alignment suggested by landowners. The alignment would be approximately 0.8 miles long, and it would connect to Reach 2B approximately 0.9 river miles upstream of Mendota Dam and to Reach 3 approximately 0.5 river miles downstream.

Construction of the bypass would require several structures. A bifurcation/diversion structure would be needed at the upstream end of the bypass to divert flows into the bypass and/or into Mendota Pool as well as maintain the operating elevation in Mendota Pool. To prevent fish from entering Mendota Pool, fish screens and barriers would be constructed at either end of the bypass. To accommodate the relatively large channel drop from inlet end to outlet end and prevent channel downcutting, a series of drop structures would be constructed within the bypass channel. This alignment connects to Reach 2B between the Columbia Canal water diversion and Mendota Dam, so a siphon would need to be constructed near the upstream end of the bypass to connect the Canal to Mendota Pool. The alignment also crosses Road 10 ½, and a crossing may be required. See Section 7.2 for a discussion of the options under consideration for each structure.

Option MPB-2 is expected to also include canal relocations, utility relocations, pump station relocations, and floodproofing of groundwater wells, but these have not been quantified at this time.

The infrastructure that would be required for this option includes the following:

- Mendota Pool Bypass bifurcation/diversion structure
- Mendota Pool Bypass fish screens (upstream end)
- Mendota Pool Bypass fish barriers (downstream end)
- Mendota Pool Bypass drop structures
- Columbia Canal siphon and pipeline
- Road 10 ½ crossing

Construction
Construction of this option would involve excavating a new channel through existing farm fields, construction of levees to protect the remaining lands, and several infrastructure modifications to accommodate the new alignment. In addition, because the option effectively shortens the channel length of the river, which in turn steepens the overall gradient of the bypass compared to the existing river, drop structures would be incorporated in the bypass channel.

Operation & Maintenance
Operation and maintenance of this option would involve periodic maintenance and repairs on the levees, fish screens and barriers, bifurcation structure, drop structures, and crossing.

Cost
The capital costs for Option MPB-2 are estimated to be comparable to Option MPB-1. Since Option MPB-2 would drain a larger portion of the existing Pool than Option MPB-1, this Option may have additional mitigation costs associated with conversion of habitats and the potential die back of existing vegetation.

Hydrologic/Hydraulic Modification
In-stream hydrologic and hydraulic modifications are expected to be primarily related to the width of the floodplain (see Section 7.1.4) and the design of the drop structures (see Section 7.2.7). Seepage and drainage impacts will be addressed as part of the design.

Fish Suitability
Fish passage should not be an issue in this alignment as long as drop structures are sized and installed at the correct elevation and the fish barrier, bifurcation structure, and screens are designed for the fish passage needs of the reach. Fish habitat in the channel itself is contingent upon the channel design.

MPB-3 (Fresno Slough Dam)

This alignment option involves relocating Mendota Dam approximately 0.5 river miles upstream to Fresno Slough and just north of the Delta Mendota Canal. The Pool would be located within Fresno Slough, and flow in Reach 2B would continue to Reach 3 through its historical alignment. The existing Mendota Dam would be removed or modified.

Construction of this option would require several structures to maintain water diversions from the Pool. This alignment would disconnect the Columbia Canal water diversion from the Pool, so a siphon would need to be constructed under Reach 2B, and the Canal would need to be extended south to the new Pool. This alignment also disconnects both the Main Canal and the Helm Ditch from the Pool, so a portion of these features would be realigned to connect to the new Pool. To maintain the possibility of Friant deliveries to the new Pool, a bifurcation/diversion structure with fish screens would need to be constructed in Reach 2B or at the Chowchilla Bifurcation Structure as well as a canal for water deliveries from the bifurcation/diversion structure to the new pool. See Section 7.2 for a discussion of the options under consideration for each structure.

Option MPB-3 is expected to also include canal relocations, utility relocations, pump station relocations, and floodproofing of groundwater wells, but these have not been quantified at this time.

The infrastructure that would be required for this option includes the following:

- Fresno Slough Dam
- Mendota Dam modification
- Columbia Canal siphon
- Columbia Canal extension
- Main Canal realignment
- Helm Ditch realignment
- Pool deliveries bifurcation/diversion structure
- Pool deliveries fish screens
- Canal for water deliveries to the Pool

Construction

Construction of this option involves building a new concrete spillway dam in Fresno Slough that would provide a pool and enable diversions of water deliveries from the Delta Mendota Canal and the San Joaquin River. The new dam would be across the mouth of Fresno Slough adjacent to an existing bridge crossing. Modification of the existing Mendota Dam would involve removing the flashboards and construction of additional features to enable fish passage over the concrete foundation.

Operation & Maintenance

Operation and maintenance has not been quantified at this time but is expected to involve standard inspections and maintenance of the new dam and periodic maintenance and repairs on the diversion structure and canal.

Cost

The capital costs of Option MPB-3 cannot yet be compared to the costs of Options MPB-1 and MPB-2 because they are highly dependant on the location of the canal for water deliveries. Since Option MPB-3 would drain most of the Pool, this Option may have significant mitigation costs associated with conversion of habitats and the potential die back of existing vegetation.

Hydrologic/Hydraulic Modification

Option MPB-3 is expected to result in significant hydrologic modification for existing wetlands and riparian vegetation around Mendota Pool. This could have a significant adverse effect on wetlands, waters, and species. However, MPB-3 will not require fish barriers, so hydraulic modification in Reach 3 may be somewhat different as compared to MPB-1 and MPB-2.

Fish Suitability

This option is expected to have fishery benefits due to the restoration of the historic river channel to free-flowing conditions and the restoration of the historic migratory pathway.

7.1.4 Mendota Pool Bypass Floodplain

Floodplains can provide significant benefits for the rearing habitat of migrating juvenile fish. Because Reach 2B and the Mendota Pool Bypass both have the potential to offer rearing habitat for migrating juveniles, floodplain options for the Bypass are considered in this TM.

Floodplain options along the Mendota Pool Bypass cover a range of floodplain widths based on varying floodplain depths and floodplain roughness characteristics (see Table 7-8) Floodplain options are presented for both the Settlement (Option MPB-1) and Compact (Option MPB-2) bypass alignments (see Figure 7-3 and Figure 7-4, respectively). Options MPBFP-1 and MPBFP-2 also include vegetation management to achieve the desired floodplain roughness and maintain capacity. Mendota Poll Bypass Floodplain Options vary over the range from most rough to moderately rough to least rough and are described in terms of differing types and combinations of vegetation. It should be noted that while Option roughness is described in terms of vegetation, floodplain roughness also includes elements such as side channels, woody debris, irregular grading, habitat features and complexity

The Mendota Pool Bypass floodplain options may be combined with the corresponding Reach 2B Floodplain Options (see Section 7.1.2) or may be combined with differing Floodplain Options. In the future, should differing options be combined, then a floodplain width transition would be incorporated into the alternative. Transitions are not evaluated at this time.

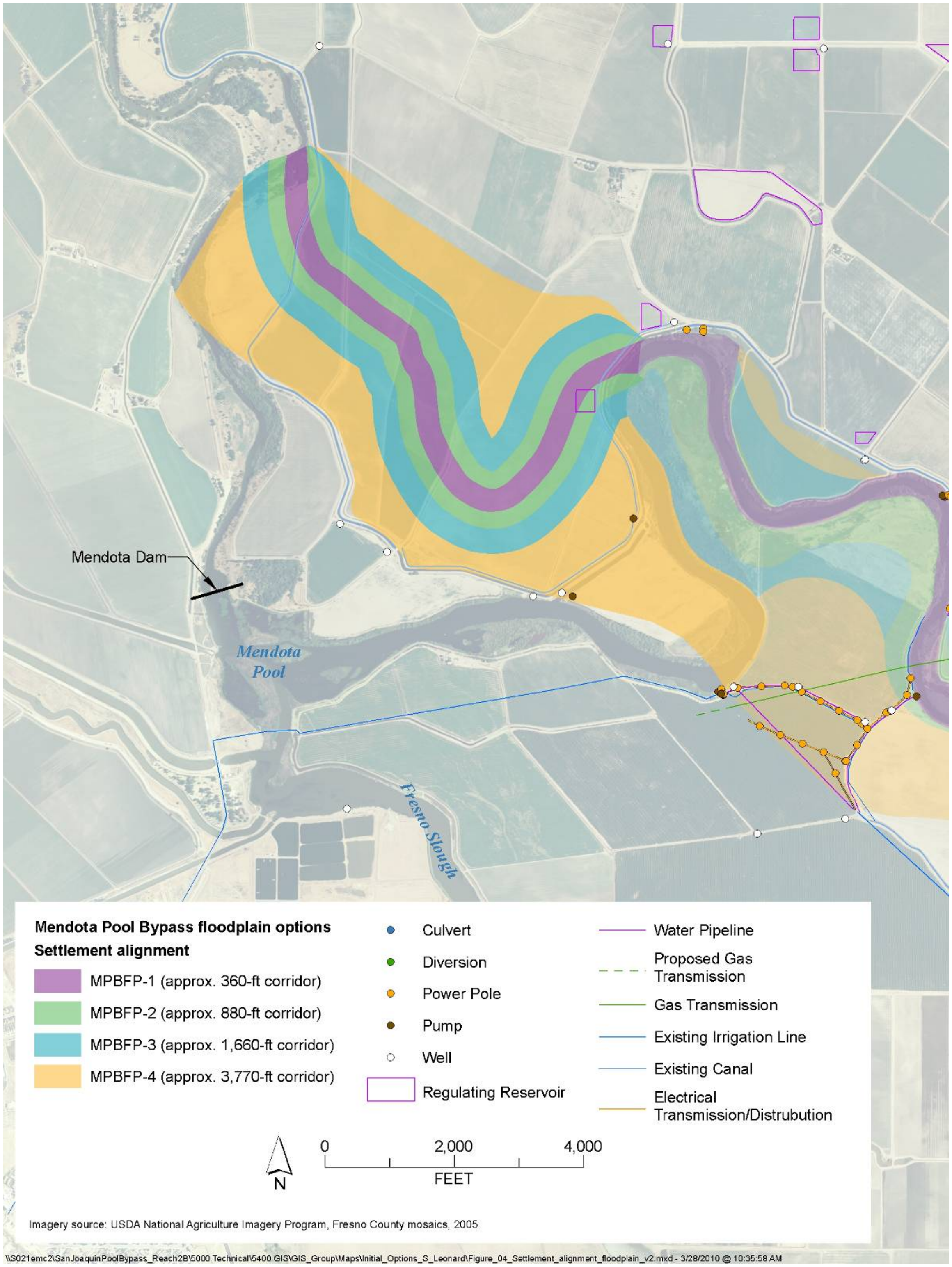


Figure 7-3
Mendota Pool Bypass Floodplain Options – Settlement Alignment

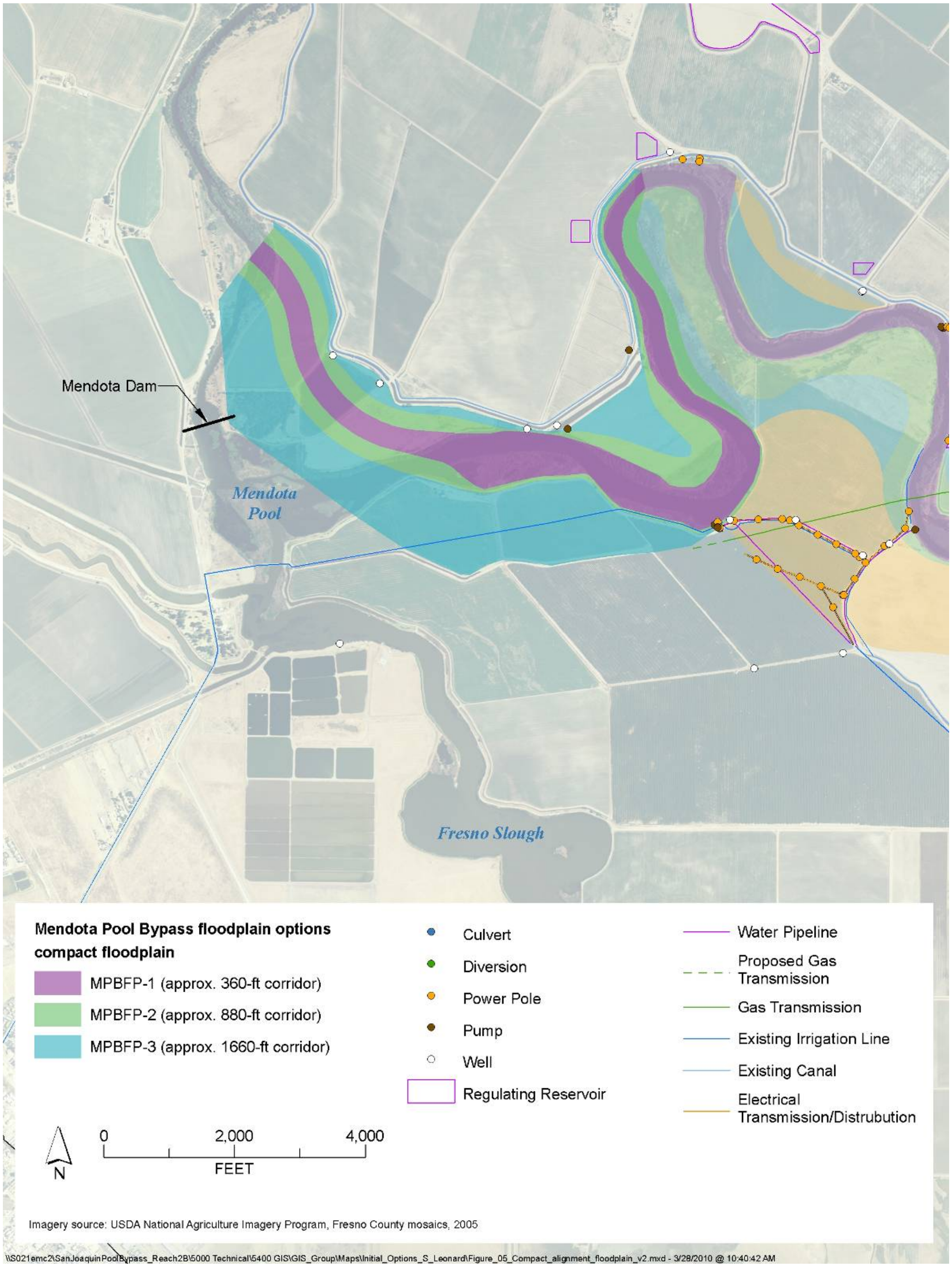


Figure 7-4
Mendota Pool Bypass Floodplain Options – Compact Alignment

Table 7-8
Mendota Pool Bypass Floodplain Options

Option ID	Description
MPBFP-1	Levee alignments with 360-foot-wide corridor, and manage to prevent establishment of woody vegetation.
MPBFP -2	Levee alignments with 880-foot-wide corridor, and manage to prevent establishment of woody vegetation.
MPBFP -3	Levee alignments with 1,660-foot-wide corridor, allow establishment of woody vegetation in defined riparian corridor, and manage to prevent establishment of woody vegetation beyond riparian corridor.
MPBFP -4	Levee alignments with 3,770-foot-wide corridor, and allow establishment of woody vegetation throughout floodplain.

MPBFP-1 (360-foot corridor)

In this option, the proposed levee alignments would correspond to the approximate width of the existing levees along Reach 2B, or approximately 360 feet wide. Levee heights would be designed to accommodate 4,500 cfs and 3 feet of freeboard within the proposed alignments. Levee lengths and heights have not yet been estimated for this option.

Option FP-1 would also include removal of all woody vegetation within the levee alignments, including the floodplain, for the purposes of creating sufficient channel capacity and limiting channel roughness (reach average Manning's n value of 0.055). Vegetation would be permanently maintained to prevent the reestablishment of woody vegetation. Grasses would be allowed to establish within the levee alignments. Floodplain habitats would be limited to grassed floodplains throughout the reach. In-channel habitat would be minimal.

Construction, operation and maintenance, cost, hydrologic and hydraulic modification, habitat restoration potential, fish suitability, and geomorphology are expected to be similar to the discussion provided for Option FP-1 in Section 7.1.2.

MPBFP-2 (880-foot corridor)

In this option, the floodplain would be constructed to an average width of 880 feet to accommodate minimal floodplain roughness. Levee heights would be designed to accommodate 4,500 cfs and 3 feet of freeboard within the proposed alignments. Levee lengths and heights have not yet been estimated for this option.

Option FP-2 would also include removal of all woody vegetation within the levee alignments, including the floodplain, for the purposes of creating sufficient channel capacity and limiting channel roughness (reach average Manning's n value of 0.055). Vegetation would be permanently maintained to prevent the reestablishment of woody vegetation. Grasses would be allowed to establish within the levee alignments. Floodplain habitats would be limited to grassed floodplains throughout the reach. In-channel habitat would be minimal.

Construction, operation and maintenance, cost, hydrologic and hydraulic modification, habitat restoration potential, fish suitability, and geomorphology are expected to be similar to the discussion provided for Option FP-2 in Section 7.1.2.

MPBFP-3 (1,660-foot corridor)

In this option, the floodplain would be widened to an average width of 1,660 feet to accommodate a moderate floodplain roughness. Levee heights would be designed to accommodate 4,500 cfs and 3 feet of freeboard within the proposed alignments. Levee lengths and heights have not yet been estimated for this option.

Option MPBFP-3 would allow the establishment of woody vegetation adjacent to and within some distance of the channel to create a riparian corridor. Beyond the riparian corridor, vegetation management would be used to prevent the establishment of woody vegetation. In these areas, vegetation would be permanently maintained to prevent the establishment of woody vegetation.

Typical habitats would include a narrow woody riparian ribbon adjacent to the channel and along the banks, and the remainder of the floodplain habitat outside the riparian ribbon would typically be limited to grassed floodplains. The opportunity exists to distribute the grassed and woody habitats in multiple configurations on the floodplain to create more heterogeneous habitat mosaics; however, it should be noted that in order to maintain the design corridor roughness reach-wide, the habitats will primarily consist of grassed floodplains (approximately 70 percent of floodplain acreage).

Construction, operation and maintenance, cost, hydrologic and hydraulic modification, habitat restoration potential, fish suitability, and geomorphology are expected to be similar to the discussion provided for Option FP-3 in Section 7.1.2.

MPBFP-4 (3,770-foot corridor)

In this option, the floodplain would be widened to an average width of 3,770 feet to accommodate a high floodplain roughness. Levee heights would be designed to accommodate 4,500 cfs and 3 feet of freeboard within the proposed alignments. Levee lengths and heights have not yet been estimated for this option.

Option MPBFP-4 would allow the establishment of woody vegetation across the entire floodplain. Areas between the proposed levee alignments would not be managed, allowing additional woody vegetation to establish by either natural processes and regeneration, through planting, or a combination of both.

This Option has sufficient width to include forested riparian habitat throughout the floodplain. This Option also has the greatest opportunity for providing varying habitats in multiple configurations on the floodplain to create more heterogeneous habitat mosaics. Additional habitats to combine with forested riparian could include grassed floodplains, marshes, high flow side channels, and scrub riparian.

Construction, operation and maintenance, cost, hydrologic and hydraulic modification, habitat restoration potential, fish suitability, and geomorphology are expected to be similar to the discussion provided for Option FP-4 in Section 7.1.2.

7.2 Structure Options

Structures in the channel can affect whether flow conveyance, water supply, fish habitat and passage, and geomorphology goals and objectives would be met by the Project. For example, structure capacity and functionality affect the flow conveyance and water supply goals, velocity and flow depth conditions in structures affect fish passage, and scour conditions at structures may affect fish habitat and geomorphology goals. Options for structures are described in the following sections. The structures are generally ordered from upstream to downstream location in the reach.

7.2.1 Chowchilla Bifurcation Structure Fish Passage

Although modifications to the Chowchilla Bifurcation Structure are defined in the Settlement as Phase 2 improvements, providing fish passage through the San Joaquin River is critical to meeting the Settlement Restoration Goal. Therefore, fish passage at the Chowchilla Bifurcation Structure is being addressed in this TM.

The Chowchilla Bifurcation Structure includes two components, the Chowchilla Bypass Canal Gate Control Structure and the San Joaquin River Gate Control Structure. This section addresses the modifications that would be required at the San Joaquin River Gate Control Structure component to facilitate fish passage, particularly under low flow conditions.

The structure is composed of four bays, each containing a large radial gate that is used to regulate flows. The bottom reinforced concrete slab in each gate bay has a slight slope in the downstream direction. A 2-foot high weir wall along the downstream edge of the foundation mat and a series of baffle blocks on the mat downstream from the gates dissipate flow energy through the gate structure and minimize downstream channel erosion. The weir wall in combination with the lack of a downstream jump pool and lack of concentrated low flow impedes upstream and downstream fish passage under low flow conditions.

Options to improve the fish passage capability through the structure include modifying the existing structure or adding a separate facility to facilitate fish passage. Adding separate fish passage facilities would include constructing a new bypass facility in the backfill on either side of the existing structure immediately adjacent to the side walls. The bypass could be a culvert or a full-height bay. Both would require gates on the upstream side to control flow, channelization to the inlet and outlet, and cuts through the existing high wing walls to accommodate the inlet and outlet. Because of the complexity and anticipated cost of this option compared with modifying the existing structure, providing a new bypass facility has not been carried forward. See Table 7-9.

Table 7-9
Existing San Joaquin River Control Structure Modification Options

Option ID	Description
SJRS-1	Modify Existing Structure.

SJRS-1 (modify existing structure)

Modify the concrete weir wall along the downstream edge of the structure foundation mat to facilitate fish passage under low flow conditions.

Construction

Under low flow conditions, the weir wall would impound a minimum of two feet of water over the top of the structure mat. One or more notches would be cut in the wall to pass low flows and facilitate passage to or from the existing downstream pool. If water depth on the slab is a concern, the height of the weir wall could be increased, within limits, without adversely affecting the capacity of the structure. Rip rap would be reconfigured immediately downstream of the notches to provide staging and acceleration areas for fish to access and pass upstream through the notches. Hydraulic analysis would be required to determine how high the wall could be raised without impacting the hydraulic performance of the structure.

Operation and Maintenance

Operation and maintenance would be minimal, limited to insuring that notches are clear of debris and the downstream pool is kept free of sediment.

Cost

Cost would be minimal.

Hydrologic/Hydraulic Modifications

The modifications should not adversely affect the operation of the gate control structure, or its capacity to pass water to the San Joaquin River.

Fish Suitability

The proposed modifications should be suitable for fish passage

7.2.2 Chowchilla Bifurcation Structure Fish Screen

Although modifications to the Chowchilla Bifurcation Structure are considered Phase 2 improvements, a brief discussion of fish screening is summarized here as the level and type of screening facilities at this structure could impact the success of the Phase 1 improvements with regards to fish migration.

The Chowchilla Bifurcation Structure Fish Screen Facilities would be constructed in a separate gate-controlled screening structure adjacent to the existing Chowchilla Bypass Canal Gate Structure. Details of the fish screen, bypass, and cleaning system would be similar to those presented in Section 7.2.4 for the Mendota Pool Bypass Bifurcation Structure.

Before details of the fish screen structure can be developed, the screening goal and design flow must be established. The size, complexity, and cost of the structure would increase with design flow. It may not be practical or necessary to consider screening for the full capacity of the Chowchilla Bypass Canal Control Structure.

7.2.3 San Mateo Avenue & Road 10 ½ Crossings

Two road crossings would exist within Reach 2B and the Mendota Pool Bypass: San Mateo Avenue crossing and Road 10½ crossing. Assuming that through consultation with Fresno County and landowners suitable arrangements can not be made to eliminate the need for the two crossings, both would require modification to facilitate fish passage and to provide access during an acceptable range of Restoration Flows. Options being considered assume that some portion of flows would pass under the road through a suitable conveyance or open area. Once the capacity of the undercrossing is exceeded, excess flow would pass over the top of the road, which would act as a broad crested weir.

Several factors must be considered to establish the design flow for the undercrossing, including the frequency and duration of overtopping flows and their effects on adjacent land operations. As a minimum, the undercrossing should be designed for a flow of approximately 250 cfs, which is the approximate flow expected at the crossing sites in Reach 2B when 350 cfs is being released at Friant Dam. This would result in the crossing being overtopped relatively frequently (at least once a year). However, the crossing design flow could alternatively be based on the maximum Restoration Flow expected in Reach 2B or a high flood flow, which would result in a relatively less frequent overtopping event. Selection of the design flow would be based on consultation with landowners and other stakeholders and dependent on the desired frequency of overtopping.

The options presented here are for the purposes of providing a range fish passage conditions and opportunities. All of the options presented could be designed for a range of design flows. Fish passage options presented herein would be applicable at both road crossing locations. See Table 7-10.

Table 7-10
Road Crossing Fish Passage Options

Option ID	Description
RC-1	Circular Culverts.
RC -2	Bottomless Arch Culverts.
RC -3	Boxed Structures.
RC -4	Bridges.

RC-1 (circular culverts)

The option to install circular culverts would include a multiple barrel culvert designed to pass the design flow as well as provide fish passage over a range of flows, including low flows. Low flow fish passage may be accommodated by setting one barrel at a lower elevation than the remaining barrels, which would concentrate low flows and help maintain flow depths through the culvert. During flows higher than the selected design flow, water would pass over the roadway surface.

Construction

Round culverts under an elevated road section would be constructed of corrugated metal, concrete, or plastic. Concrete and plastic pipe are less susceptible to corrosion and present a smooth surface compared with corrugated pipe. All three types of pipe are readily available and easy to install. The road surface and side slopes where flow can pass over the road must be properly constructed and armored against erosion when the road is overtopped. To prevent undermining of the culverts in the mobile bed substrate, cutoff walls would be constructed at the upstream and downstream ends effectively acting as head walls.

Operation and Maintenance

Round culverts require regular inspection and maintenance to clean out debris and control any local erosion that might be occurring near the culvert inlets and outlets.

Cost

When properly installed and embedded, round culverts are a relatively inexpensive option for road crossings.

Hydrologic/Hydraulic Modifications

Round culverts are suitable for use where the slope of the bottom of the culverts ranges from 0 percent to 3 percent.

Fish Suitability

When properly installed and embedded, round culverts can be a fish friendly option for road crossings. However, incorrect sizing or installation can cause damage to stream habitats, fish and other stream organisms.

RC-2 (bottomless arch culverts)

Bottomless arch culverts provide fish passage capability under roads for low flow conditions. They also provide the ability to maintain a more natural river bed substrate through the length of the culvert. Typically, the culvert is sized to pass a design low flow. Flows that exceed the design low flow pass over the road adjacent to the culvert through a vertically depressed section that functions as a long overflow weir. Figure 7-5 shows the typical relationship between the low flow culvert and the roadway weir section. Selecting the size of culvert and the location and length of the roadway weir section are important factors in minimizing excessive velocities through the culvert during high flow events.

Construction

Bottomless arches can be constructed of metal or concrete. Bottomless arch culverts are typically mounted on edge footings that extend below the scour line. As with the round culverts (Option RC-1), construction would require a new roadway surface on top of the bottomless arch culverts properly designed to accommodate overtopping. To prevent undermining of the culverts in the mobile bed substrate, support walls and footings would be located below the estimated scour depth. Cutoff walls would also be provided at the upstream and downstream ends of the structure, if required, to prevent erosion failures.

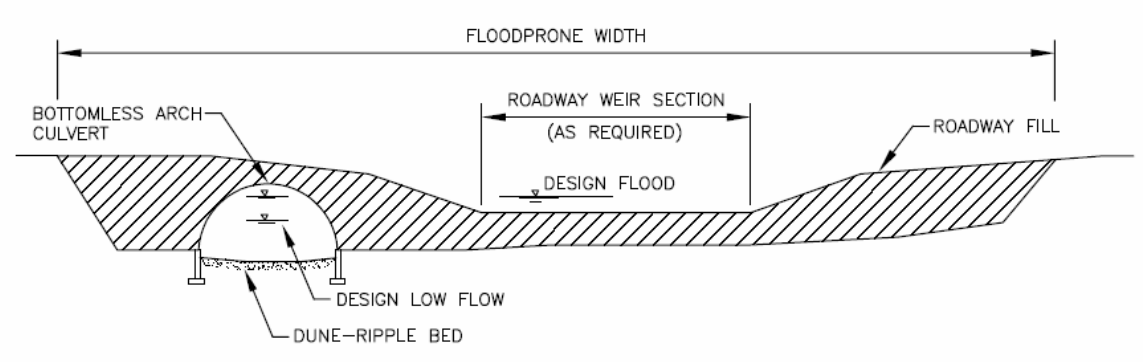


Figure 7-5
Typical Bottomless Arch Culvert with High Flow Weir

Operation and Maintenance

Bottomless arch culverts are not as prone to accumulation of debris as round culverts and can be easier to access for inspection and maintenance.

Cost

Bottomless arch culverts have relatively high up-front installation costs.

Hydrologic/Hydraulic Modifications

Bottomless arch structures may be used at sites where the slope of the riverbed is between 0 percent and 6 percent. Note for the two crossings within Reach 2B, the stream bed slope is flat (approximately 0.00036 feet/foot). This condition will help to limit flow velocities in the culverts and the streambed.

Fish Suitability

Bottomless arches provide a natural stream channel between the sides of the arch providing a smoother transition from downstream to upstream channel conditions. This allows a more natural stream channel process to take place that would maintain favorable fish passage under the structure. Bottomless arches, depending on their size may affect fish movement from the enclosed “tunnel effect” relative to passage up the open channel.

RC-3 (box culverts)

Boxed structures involve installation of one or more parallel box culverts under the road crossing. Fish passage may be accommodated by setting a narrower box at a lower elevation than the remaining boxes or by including a low flow channel in the bottom slab of a cast-in-place box, both of which would concentrate low flows and help maintain flow depths through the culvert. Additionally, it is recommended that the culverts be countersunk an appropriate depth (considering dune height) to allow for a natural substrate bottom in the culverts. During flows higher than the selected design flow, water would pass over the roadway surface.

Construction

Box culverts are usually made of concrete and may be purchased as pre-fabricated units of various lengths, or fabricated in place. Box culverts are commonly used where traffic loads (Levee District or mining operations trucks and equipment) or higher fill levels place heavy stresses on structure. As with the round culverts (Option RC-1), construction would require a new roadway surface on top of the concrete box culverts properly designed to accommodate overtopping. To prevent undermining of the culverts in the mobile bed substrate, cutoff walls would be constructed at the upstream and downstream ends effectively acting as head walls.

Operation and Maintenance

Debris can accumulate inside concrete box culverts. However, the dimensions can be selected to facilitate periodic inspection and cleaning.

Cost

The cost of concrete box culverts can be more than the cost for round culverts. The cost difference can become significant if the box culverts are cast-in-place rather than prefabricated.

Hydrologic/Hydraulic Modifications

Box culverts are suitable for use where riverbed slopes range from 0 percent to 3 percent.

Fish Suitability

Flat-bottom culverts can have problems including a vertical jump at the outlet, water too shallow inside the culvert for fish to swim, and high water velocities inside the culvert that act as a fish barrier. Some of these problems can be addressed if the culvert is cast-in-place. The design of the culvert bottom slab could incorporate a low flow channel section that concentrates the flow.

RC-4 (bridge)

Bridges would involve either bridging the entire width of the river and floodplain corridor or bridging only a portion of that width with embankments supporting the road for the remaining width. A bridge over the entire floodplain allows the river the full floodplain width for lateral migration and maintains natural channel morphology processes between the areas upstream and downstream of the bridge. Bridging a portion of the width would provide the necessary access across the corridor but requires floodplain flows to be concentrated into the channel to pass under the bridge. Either design can accommodate fish passage, but the shorter bridge may have additional erosion, scour, and geomorphological issues. Bridges can be designed using either a low flow crossing which accommodates roadway overtopping or using a high design flow to limit overtopping. In addition, bridges can be designed with piers and pilings or with open spans. Open spans could clear then entire corridor, or portion of the corridor, or only the channel.

Construction

Bridges can be constructed of metal or concrete and consist of a span across a stream that is supported by several piers or pilings. The piers or pilings are mounted on footings that extend below the scour line. To construct a bridge, the current crossing would be removed and replaced with a bridge. The span of the bridge and length of approach abutments on both sides across the channel would be selected to minimize upstream backwater effects.

Operation and Maintenance

Bridges are less prone to accumulation of debris than round culverts or concrete box culverts.

Cost

Bridges have relatively high capital construction costs, relative to the other crossing options, but may have lower maintenance costs.

Hydrologic/Hydraulic Modifications

An advantage of bridges is that they provide a greater natural stream channel surface area than bottomless arches, because the span between piers or pilings is typically larger than the span between arches. Therefore, the head loss in the channel across the bridge would be less for bridges than for the other road crossing options.

Fish Suitability

Like a bottomless culvert, bridges provide a natural stream channel between the piers or pilings or under open spans. This allows for natural stream channel processes to take place that would maintain favorable conditions for fish passage under the structure. An advantage of bridges is that they provide a greater natural stream channel surface area than bottomless arches, because the span between piers or pilings is typically larger than the span between arches.

7.2.4 Mendota Pool Bypass Bifurcation Structure

A bifurcation structure (see Table 7-11) would be required at the confluence of Reach 2B and the upstream end of the new Mendota Pool Bypass for Options MPB-1 and MPB-2. The structure would have two components. One gate structure would direct and regulate flow into the Mendota Pool Bypass. A second gate structure would regulate water deliveries of up to 2,500 cfs to the Pool and provide containment of the backwater resulting from the Pool operating elevation, which could extend upstream beyond the Mendota Pool Bypass if unregulated. The gate structure controlling the water deliveries would likely incorporate a chevron-style fish screening facility upstream to avoid entraining fish (see Section 7.2.5). Fish removed in the screening facility would be returned to Reach 2B upstream of the facility or to the Mendota Pool Bypass.

For Option MPB-3, the bifurcation structure would be located further upstream on Reach 2B at a location where Friant deliveries can be diverted from the left bank of the river into a new canal that would connect to the Pool. Factors that affect the location of this structure include: the cost of relocations, the use of lift pumps versus gravity flow, the impacts of an additional structure in the river versus adding bays to the existing Chowchilla Bifurcation structure, and the proposed Reach 2B setback levee alignments. River hydraulics would determine if a gate structure on the main stem of the river would be required to pool water to make deliveries. Detailed modeling for the option would be required to determine what regulation would be required on the river. For the current presentation of options, it is assumed that the bifurcation structure used for all three Mendota Pool Bypass Channel Options would be the similar. If it is determined for Option MPB-3 that a pool on the main stem of the river is not required for water deliveries, then the only facility that would be required would be a gate structure and fish screen component to regulate the water deliveries. Fish removed in the screening facility would be returned to the San Joaquin River.

This section addresses the diversion structures. Fish screening options are presented in Section 7.2.5.

Table 7-11
Bifurcation Structure Option

Option ID	Description
STR-1	Bifurcation Structure.

STR-1 (bifurcation structure)

The bifurcation structure would be similar to the existing structure at the Chowchilla Canal Bypass. One gate structure would regulate flows and guide fish into the Bypass Channel. A second gate structure would regulate water deliveries to the Pool.

The gate structure controlling the Bypass Channel would be capable of passing the maximum Restoration Flow of 4,500 cfs. Based upon preliminary estimates, the structure would include four gate bays, each containing a radial gate. Note that Obermeyer-style inflatable bladder gates could also be used to regulate flows as an equipment option. At least one of the gate bays would be sized small enough so that water depths and flow velocities would facilitate fish passage under lower flow conditions.

The Pool water deliveries control structure would be capable of passing at least 2,500 cfs to the Pool. Based upon preliminary estimates, the structure would include at least two gate bays, each containing a radial gate. Note that Obermeyer-style inflatable bladder gates are not recommended to regulate flows in this application because they would need to remain inflated most of the time, which presents a high fatigue failure risk. The upstream portion of the gate structure would likely include fish screens in a chevron-shaped configuration. The fish screen section would be wider than the gate section and the two sections would be joined by a tapered channel section. The fish screen section would include channels, piping, fish friendly pumps (if required by the hydraulics), and other appurtenances necessary to return fish to Reach 2B or to the Bypass Channel.

Construction

Structures would be of reinforced concrete supported on foundation piling. Radial gates would have wire rope hoists and stainless steel sealing surfaces and embedded metalwork. Bar racks would be provided on the upstream side of gate structures to capture floating debris. Automated bar rack cleaning systems can be provided. Bar spacing would be large enough to avoid entraining upstream or downstream migrating fish. Automated and manual control systems would be provided to control all water-related operations. All structure foundations would incorporate upstream and downstream cutoffs to minimize seepage and prevent damage to the structure from erosion during flood events. All-weather access to all structures would be provided.

Operation and Maintenance

Operation and maintenance of gate structures (excluding fish screens) should be the same as occurs at similar facilities like the existing bifurcation structure at the Chowchilla Canal Bypass. Periodic cleaning of bar racks would be required to remove debris and avoid head buildup in excess of 0.3 feet. Cleaning would be of particular concern during the first significant flow event during the year (first flush) and during major flood events when floating debris is most prevalent in the river.

Cost

Bifurcation structures represent a major financial investment.

Hydrologic/Hydraulic Modifications

The influence of bifurcation structures on river hydraulics must be evaluated. They would influence water elevations in the river by their presence and operation, and the level of protection required for surrounding facilities, such as the crest level for flood control levees.

Fish Suitability

When properly sized and designed, the bifurcation structures themselves should meet criteria to facilitate fish passage and minimize entrainment.

7.2.5 Mendota Pool Bypass Fish Screen

The gate structure controlling the water deliveries to the Pool may require a fish barrier or fish screening facility to avoid entraining fish whenever deliveries are being made. Fish barriers like those described in Section 7.2.6 are not considered practical for the water deliveries application and are not considered further. Fish screening can be accomplished using rotating drum screens, vertical screens, inclined screens, or horizontal screens. Of these, the vertical screens would be preferred for this application because they contain no moving parts, can be sealed against side leakage that could entrain fish, can be effectively cleaned with a brush cleaning system, and represent proven technology. See Table 7-12.

Table 7-12
Mendota Pool Bypass Fish Screen Options

Option ID	Description
FS-1	Vertical Fixed Plate Screens.

FS-1 (vertical fixed plate screens)

The fish screen facility would consist of several bays each with two vertical screen faces arranged in a chevron formation (from an aerial viewpoint); similar to the Skinner Fish

Facility for the Banks Pumping Plant in the Delta (see Figure 7-6). The chevron formation allows larger surface area screens to fit into a smaller footprint. The screens work by passing water laterally through the screen during irrigation flows, and routing fish toward the back (narrow end) of the chevron. There the fish are captured in a bypass system and returned to the river. The mechanics of the chevron formation maintain a sweeping velocity across the face of the screens carrying fish to the narrow end of the chevron without impingement.

Construction

Design of the fish screen facility would conform to current NMFS Guidelines, vertical fixed screens would be fabricated from perforated plate or wedge wire with an opening size that would exclude juvenile fish. To provide the required screen area and meet other applicable flow and velocity criteria, a chevron screen arrangement would be employed. Water for deliveries to downstream channels would pass through the screens. Bypass water with fish would proceed to the narrow end of the chevron where a bypass system would collect and return the fish to the river, or to the Mendota Pool Bypass.

Water deliveries passing through the screen structure would be drawn from an upstream pool formed by the coordinated operation of the gates in the Mendota Pool Bypass Control Structure and the gates at the downstream end of the fish screen outlet structure. The screen structure would be segmented so that one chevron section can be out of service while the other is fully functional. The pool elevation would provide sufficient head to pass water through the screens and to effectively operate the fish bypass system.

Mechanically operated brush cleaning systems would be provided to remove debris from the screen panels. To intercept and remove large floating debris before it reaches the screens, trash racks and trash rack cleaning systems would be provided at the upstream end of the screen structure. Flow velocities through the trash racks and in the channel system downstream would be high enough to route juvenile fish through the facility and to the bypass system at the far end.

The bypass facility would efficiently and safely move fish from the screen structure back to Reach 2B, or to the Mendota Pool Bypass. Bypass piping and channels would have smooth surfaces and a minimum of large radius bends. The bypass flow volume should be a minimum of 5-percent of the diverted flow. For years when flow in the Mendota Pool Bypass is too low to maintain flow connectivity, other methods may be employed to route fish downstream. Outfall details would be carefully considered to ensure safe delivery of fish to the receiving water body and to avoid attraction flows. A Sampling Facility would be provided in the bypass system. Because of the size of the facility and maximum diversion flow anticipated, the preliminary design of the facility should include close coordination and consultation with NMFS and the Department of Fish and Game to finalize facility-specific design criteria and agree on preliminary arrangement.

Operation and Maintenance

Vertical fixed plate screens are mechanically simple and easy to seal around the screen perimeter to avoid unanticipated entrainment of fish. Debris accumulation is a concern that can be addressed using a brush cleaning system or backspray system. The brush cleaning system would be preferred because it is less complicated and does not need pumps and compressors to operate. The brush cleaning system would be operated on a timer with an over-ride control to operate if differential pressure across the screen panels exceeds preset limits between regular cleaning cycles.

Cost

Vertical fixed plate screens can represent a significant initial investment, particularly if screen panels and support structures are constructed of stainless steel, but operation and maintenance would be lower than for other screening systems.

Hydrologic/Hydraulic Modifications

Accumulation of debris on the screens can reduce the total area available for passage of flow through the screen. This would increase the head differential across the screens unless the cleaning system is provided. Trash racks would also require periodic cleaning to remove trash and prevent clogging.

Fish Suitability

The style of screen described herein is commonly used in California and has been found to be effective (up to 95 percent fish guidance efficiency) (NMFS 1994).

Figure 7-6
Skinner Fish Facility

7.2.6 Mendota Pool Bypass Fish Barrier

Fish barriers direct fish away from unsuitable pathways and into suitable pathways for migration. For upstream migrating individuals, fish should be directed into the Mendota Pool Bypass and away from the base of Mendota Dam in order to dead-end pathways, prevent migration delays, and reduce stress. Typically fish will follow the pathway with the greatest flow, but deliveries of up to 300 cfs are made from Mendota Pool to Arroyo Canal via Reach 3, and the water delivery flow in Reach 3 may exceed the Restoration Flow in the Mendota Pool Bypass depending on the timing of deliveries and the water year. A fish barrier option is, therefore, included in the Project due to these potential conditions.

A suitable fish barrier may be placed in Reach 3 just upstream of the confluence with the Mendota Pool Bypass channel to direct upmigrating fish into the bypass channel. The barrier would be required for two Bypass Channel Options: MPB-1 and MPB-2. A barrier would not be required if the Pool is relocated (MPB-3). For flood operations, when the boards at Mendota Dam are removed and fish can pass upstream through the dam structure into Reach 2B unimpeded, as well as pass upstream through the Mendota Pool Bypass Bifurcation Structure and Fish Screen, the barrier could be removed to prevent hydraulic modification, excessive debris collection, and maintain channel capacity.

Options for fish barriers include positive barriers and behavioral barriers. Behavioral barrier options are not proposed herein because of limited applicability and inconsistent results (guidance efficiencies less than 60 percent) (NMFS 2008). Positive barrier options include velocity barriers, drop structures, and physical barriers. Velocity barrier and drop structure options are not proposed herein because of the wide range of flows that must be accommodated and adverse impacts to river hydraulics and water surface elevations, particularly under flood flow conditions. Physical barrier options are practical and include Fixed Bar Screens and Floating Picket Weirs (see Table 7-13).

Table 7-13
Physical Barrier Options

Option ID	Description
PB-1	Fixed Bar Screens.
PB -2	Floating Picket Weirs.

PB-1 (fixed bar screens)

Fixed bar screens consist of a panel of closely spaced bars that span the width of the entire channel. The closely spaced bars prevent fish from migrating upstream. Fixed bar screens are secured to the sides and bottom of a channel and typically have no moving parts. These types of screens are prone to accumulation of debris traveling downstream and need to be cleaned periodically. Cleaning can be accomplished by manual or mechanical methods.

Construction

Fixed bar screens are constructed from metal or poly-vinyl chloride (PVC) bars. The bars are typically spaced 1-inch apart or less. The bar screen can be equipped with a deck and raking equipment to clear accumulated debris from the face of the screen.

Operation and Maintenance

Bar screens are simple structures as they have no moving parts, but are prone to debris accumulation requiring regular maintenance to clear accumulated debris from the face of the screen. While the barrier would be removed during flood operations when debris is typically a significant issue, the structure would be located approximately 0.5 to 1.5 miles downstream of Mendota Dam, and debris contributed by Reach 3 under normal operations (primarily water deliveries) may need to be considered during design.

Cost

Fixed bar screen structures can become expensive when the cost of structural elements, fabricated bar panels, and cleaning mechanisms are considered. Relative cost would be determined when a conceptual design is competed.

Hydrologic/Hydraulic Modifications

Accumulation of debris on the fixed bar screens can reduce the total area available for passage of flow through the screen. This would increase the head differential across the bar screen. The typical maximum head differential across the bar screen to keep structural proportions within reasonable limits is 0.3 feet. Whenever this threshold is exceeded the screen should be cleaned.

Fish Suitability

These types of fish barriers have a high likelihood of impinging fish and therefore cannot be used in waters containing species listed under the Endangered Species Act (ESA), unless certain measures are implemented. These measures include continual monitoring by onsite personnel and an acceptable plan to remove impinged fish in a timely manner. For this option, the direction of flow is from the Mendota Pool and Dam to San Joaquin River Reach 3, so impingement would only be an issue for fish that would be allowed to enter the Pool.

Source: Faler 2005.

Figure 7-7
Application of a Floating Picket Weir

PB-2 (floating picket weirs)

Hinged floating picket weirs consist of a panel of closely spaced bars that span the width of the entire channel in which they are placed (see Figure 7-7). The closely spaced bars prevent fish from migrating upstream. Hinged floating picket weirs are secured at the base to the bottom of the channel and span the entire width of the channel. The top of the hinged floating picket weir extends above the water surface and is allowed to float or sink, rotating about its base, depending on stream conditions. At high flows hinged floating picket weirs rotate downstream and are forced under water, allowing debris to pass.

Construction

Hinged floating picket weirs are constructed from metal or poly-vinyl chloride (PVC) bars. The bars are typically spaced 1-inch apart or less. The bars are secured at the base to the bottom of the channel and equipped with a resistance board which extends across the width of the bars.

Operation and Maintenance

Hinged floating picket weirs are mechanically simple structures as the only moving part is the hinge pivot. The structure floats or sinks depending on stream conditions. Hinged floating picket weirs allow debris to pass at high flows, so they do not require as much maintenance as fixed bar screens. However, the passage of debris downstream may be undesirable.

Cost

Hinged floating picket weirs can become expensive when the cost of structural elements, anchorages, and fabricated bar panels are considered. Relative cost would be determined when a conceptual design is competed.

Hydrologic/Hydraulic Modifications

Hinged floating picket weirs do not have a significant impact on the hydrologic or hydraulic conditions of the stream in which they are placed.

Fish Suitability

These types of fish barriers have a high likelihood of impinging fish and therefore cannot be used in waters containing species listed under the Endangered Species Act (ESA), unless certain measures are implemented. These measures include continual monitoring by onsite personnel and an acceptable plan to remove impinged fish in a timely manner. For this option, the direction of flow (predominantly during flood operations) is from the Mendota Pool and Dam to San Joaquin River Reach 3, so impingement would only be an issue for fish that would be allowed to enter the Pool.

7.2.7 Mendota Pool Bypass Drop Structures

The elevation drop that must be accommodated along the new bypass channel is estimated to be approximately 15.5 feet and 9.5 feet for bypass channel Options MPB-1 and MPB-2, respectively. This difference produces a steep gradient and flow velocities must be controlled to maintain channel stability and avoid erosion and headcutting. Options to address the steep channel gradient would include linings, various types of roughened channel, and drop structures. Because the canal invert slope must be kept low over much of its length to permit installing siphon under-crossings for the Columbia Canal, and because lining and roughened channels would adversely affect the ability to revegetate and provide habitat, lining and roughened channels are eliminated from consideration. Drop structures would include sheet pile or concrete walls or a boulder and cobble wall. Boulder and cobble walls are not proposed due to stability concerns, particularly under high flow conditions. Walls are an option to control channel hydraulics and facilitate fish passage. See Table 7-14. Collectively, the drop structures would function as a fish ladder and not as enhancements to fish habitat in the channel. They would be designed to facilitate up and downstream movement.

Table 7-14
Drop Structure Options

Option ID	Description
DS-1	Walls.

DS-1 (walls)

The number of drops would be established to maintain energy dissipation at each drop to within acceptable limits to minimize erosion and to maintain jump heights well within the limits suitable for upstream and downstream fish passage at low project flow conditions. At higher flows, drop structures would be submerged and passage would not be a problem. Five and four drops are estimated to be required for Options MPB-1 and MPB-2, respectively, near the downstream end of the channel to accomplish the required channel grade change.

Construction

Construction of drop structure weirs and downstream pools can be accomplished using sheet pile walls, or concrete walls, which would remain stable even under major flood flows. The concrete walls would be provided with rounded edges on top to minimize sharp edges. A concrete cap beam could be provided on top of a sheet pile wall to avoid sharp edges. Both walls would have one or more notches extending from the top of wall to the approximate level of the low flow channel bottom to minimize jumping and allow swim-through conditions under low flows. The number and size of the notches will be determined once more specific information is available regarding the range of low flows that would be expected.

Operation and Maintenance

The concrete wall would require little operation and maintenance, other than periodic removal of accumulated sediment to maintain required pool volumes and downstream pool depths. Operation and maintenance for the sheet pile wall would be similar to the concrete wall, except that corrosion could become a problem over time.

Cost

The cost for installing and maintaining sheet pile or concrete walls would be comparable.

Hydrologic/Hydraulic Modification
Not applicable.

Fish Suitability
Drop structures are an effective means to control channel gradients and provide for fish passage upstream and downstream, particularly if low flow notches are provided.

7.3 Levees

Levees would be designed according to the U.S. Army Corps of Engineers (USACE) *Engineer Manual 1110-2-1313 Design and Construction of Levees* (USACE 2000). These guidelines include slurry walls, inspection trenches, maintenance roads, and drainage trenches to reduce seepage. All levees would be designed with 3 feet of freeboard above the design flood elevation. Levee slopes would be 3:1 (horizontal to vertical) on the riverward side and 2:1 on the landward side. Maintenance roads and drainage ditches would run parallel and landward of the levees.

Slurry walls, where required, are currently estimated to be 15 feet deep. Levees with slurry walls would have inspection trenches 16 feet wide, 4 feet deep with 1:1 side slopes. Levees without slurry walls would have inspection trenches 12 feet wide and 6 feet deep with 1:1 side slopes.

It is currently assumed that imported fill material would be used for levee construction.

7.4 Existing Infrastructure

For all of the floodplain and bypass alignment options, existing infrastructure would be impacted to varying degrees. Infrastructure includes:

- Existing groundwater wells
- Existing lift pumps
- Existing canals
- Existing utility lines (gas and electric)

To accommodate the proposed options, existing infrastructure would be modified, relocated, and/or realigned as part of the Project. Coordination with owners and operators of existing infrastructure would be ongoing during the Project.

8.0 Summary and Next Steps

This section provides an overview of the next steps in the alternatives formulation process.

8.1 Summary

The Reach 2B Project includes the Phase 1 improvements from the Settlement that are specified in Paragraphs 11(a)(1) and 11(a)(2). Reach 2B has not received flow, except for flood releases, since the construction of Friant Dam. The Reach 2B Project includes the following specific improvements:

- Creation of a bypass channel around Mendota Pool to ensure conveyance of at least 4,500 cfs from Reach 2B downstream to Reach 3, including a new bifurcation structure to allow water deliveries to Mendota Pool
- 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
- Construction of fish passage facilities at the San Joaquin River gate of the Chowchilla Bifurcation Structure
- Improvements to the existing San Mateo Avenue crossing
- Other ancillary structures

Table 8-1 provides a summary of the options identified during development of this TM. These options will be used to gain feedback from the Implementing Agencies, Settling Parties, other participatory agencies, landowners, and the public. It is anticipated that feedback from these entities will likely increase the number and types of options to be considered for alternatives formulation. The feedback may also include additional benefits and drawbacks of the options, which will further the alternatives formulation process. Perhaps most importantly, feedback is expected to clarify and refine the project goals and objectives.

Table 8-1
Options Under Consideration for the Reach 2B Project

Option ID	Description
Reach 2B Channel Options	
R2B-1	No physical changes to the main river channel.
R2B-2	No excavation in the main river channel. Vegetation removal.
R2B-3	Some excavation in the main river channel to increase capacity. Vegetation removal.
Reach 2B Floodplain Options	
FP-1	Maintain the existing levee alignments, remove existing woody vegetation, and manage to prevent reestablishment of woody vegetation.
FP-2	New levee alignments with 880-foot-wide corridor, remove existing woody vegetation, and manage to prevent reestablishment of woody vegetation.
FP-3	New levee alignments with 1,660-foot-wide corridor, maintain existing woody vegetation, and manage to prevent establishment of woody vegetation in new areas.
FP-4	New levee alignments with 3,770-foot-wide corridor, maintain existing woody vegetation, and allow establishment of woody vegetation in new areas.
Mendota Pool Bypass Channel Options	
MPB-1	Settlement alignment of the bypass.
MPB-2	Compact alignment of the bypass
MPB-3	Relocation of Mendota Dam.
Mendota Pool Bypass Floodplain Options	
MPBFP-1	Levee alignments with 360-foot-wide corridor, and manage to prevent establishment of woody vegetation.
MPBFP -2	Levee alignments with 880-foot-wide corridor, and manage to prevent establishment of woody vegetation.
MPBFP -3	Levee alignments with 1,660-foot-wide corridor, allow establishment of woody vegetation in defined riparian corridor, and manage to prevent establishment of woody vegetation beyond riparian corridor.
MPBFP -4	Levee alignments with 3,770-foot-wide corridor, and allow establishment of woody vegetation throughout floodplain.
Existing San Joaquin River Control Structure Modification Options	
SJRS-1	Modify Existing Structure.
Road Crossing Fish Passage Options	
RC-1	Circular Culverts.
RC -2	Bottomless Arch Culverts.
RC -3	Boxed Structures.
RC -4	Bridges.
Bifurcation Structure Option	
STR-1	Bifurcation Structure.
Mendota Pool Bypass Fish Screen Options	
FS-1	Vertical Fixed Plate Screens.
Physical Barrier Options	
PB-1	Fixed Bar Screens.
PB -2	Floating Picket Weirs.
Drop Structure Options	
DS-1	Walls.

As part of the alternatives formulation process, the Project Team envisions that additional information would help develop additional options, eliminate options that are not applicable, and refine options. This additional information includes:

- Stakeholder feedback, particularly from landowners or others that are familiar with the local region
- Information on willing landowner sellers
- A sediment transport analysis to sufficiently predict and understand the effects on the system from the upstream sediment load and the sediment transport capacities of the various options
- Biological field surveys to understand the quality and extent of wetlands, various protected habitats, and special status species habitats and use. Mitigation for impacts is potentially a significant regulatory hurdle and cost for the Project, depending on the options selected

8.2 Next Steps

This TM presents the beginning of the alternatives formulation process and project description development for the Reach 2B Project. The project description would be incorporated into the future Project EIS/R. The sections below describe how the process initiated by this TM would progress towards the Project EIS/R and necessary environmental permits.

8.2.1 Pre-Appraisal Design and Feasibility Study

Pre-appraisal design is already underway for certain options presented in this TM, and is being lead by DWR. Modeling and refinement of the options would continue based on this TM and stakeholder feedback.

8.2.2 Environmental Baseline Surveys and Data Collection

Before impacts can be analyzed for the Project EIS/R, environmental baseline surveys and data collection would be needed to gather detailed information on baseline conditions. This would include biological and cultural surveys of the Project area, as well as site-specific research to document current conditions. This information would become the baseline in the EIS/R. The Reach 2B project alternatives would be compared to the baseline to evaluate potential environmental effects. The information gathered during this stage would also provide information for the permitting process.

8.2.3 Alternatives Formulation and Evaluation

In conjunction with pre-appraisal design, baseline surveys and other data collection activities, the alternative formulation process as outlined in Section 6.0 would proceed and culminate in the development of Project Descriptions to be utilized for preparation of the EIS/R and environmental permitting.

8.2.4 Project EIS/R

A Project EIS/R would be prepared for the Reach 2B Project to satisfy NEPA and CEQA requirements and facilitate stakeholder involvement. The Project EIS/R would analyze the potential environmental effects associated with the implementation of the project alternatives and would identify potential mitigation measures to reduce or avoid those effects. The Draft Project EIS/R would be released to the public for review and comment.

A Final Project EIS/R would be prepared that provides responses to the comments received on the Draft Project EIS/R. From this environmental review process, an alternative would be selected by Reclamation and DWR for implementation. Reclamation's Record of Decision and DWR's Statement of Findings would identify the alternative selected for implementation, the environmental effects associated with that alternative, and the mitigation adopted to avoid or minimize environmental effects. After the environmental review process is complete and all permits/approvals have been obtained, preparation of construction documents would begin followed by construction of the selected alternative.

8.2.5 Environmental Permitting

Prior to project implementation, environmental permits/approvals would be required from several different entities. Most of these permits/approvals must be obtained before construction can commence. Preparation of environmental permit/approval applications would be concurrent with the development of the Project EIS/R. This would allow changes to the project description to minimize or avoid environmental impacts and reduce the need for permits and mitigation. Pre-application meetings would likely be scheduled with the permitting entities at this time to ensure the correct permits are obtained and the necessary information is presented in the applications. When the draft EIS/R is released to the public, the permit/approval applications would be submitted to the appropriate entities.

8.3 Stakeholder Involvement

The Implementing Agencies recognize the importance of stakeholder involvement during alternatives development. They are committed to providing opportunities for all interested stakeholders (e.g. Restoration Administrator, Technical Advisory Committee, Settling Parties, Third Parties, other interested agencies and members of the public) to become involved in the alternatives development process to provide input on key issues that need to be considered. Stakeholders would have the opportunity to be involved in the alternatives development process by:

- Reviewing and submitting comments on this and future Reach 2B TMs
- Attending Reach 2B meetings and submitting comments or voicing concerns
- Reviewing the Draft EIS/R document for Reach 2B and submitting comments
- Attending public meetings on the Draft EIS/R document and submitting comments
- Referring to the Program website for project and document updates and opportunities for comment and reviews

8.4 Schedule

The draft schedule for the Reach 2B Project is provided in Figure 8-1 below. This schedule is preliminary and subject to change.

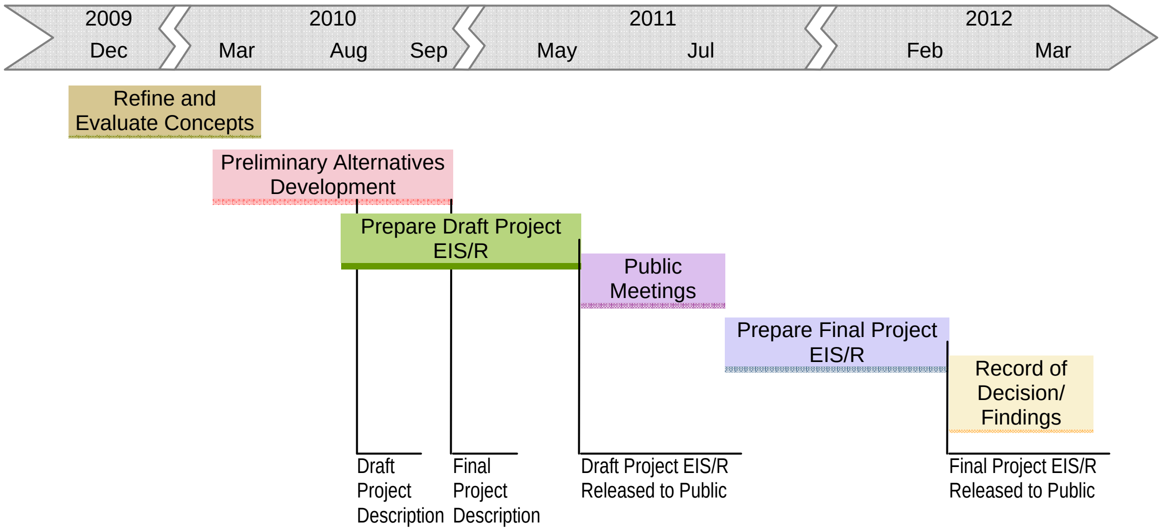


Figure 8-1
Draft Schedule for Reach 2B

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9.0 Acknowledgments

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