Appendix G

Plan Formulation

Draft
Program Environmental Impact Statement/Report

Draft
April 2011

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Attachments

List of Abbreviations and Acronyms

Banks	Harvey O. Banks Pumping Plant
Bay Area	San Francisco Bay Area
BO	Biological Opinion
CalEPA	California Environmental Protection Agency
CCR	California Code of Regulations
CEQ	Council on Environmental Quality
CEQA	California Environmental Quality Act
CESA	California Environmental Species Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
Court	U.S. Eastern District Court of California
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement Act
Delta	Sacramento-San Joaquin Delta
DFG	California Department of Fish and Game
DMC	Delta-Mendota Canal
DWR	California Department of Water Resources
EA	Environmental Assessment
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
elevation xxx	elevation in feet above mean sea level
ESA	Federal Endangered Species Act
FWA	Friant Water Authority
I/O	input/output
IPAR	Initial Program Alternatives Report
Jones	C.W. “Bill” Jones Pumping Plant
M&I	municipal and industrial
MAF	million acre-feet
msl	mean sea level
NAVD	North American Vertical Datum
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOD	Notice of Determination
NRDC	Natural Resources Defense Council

NWR	National Wildlife Refuge
PEIS/R	Program Environmental Impact Statement/Report
RA	Restoration Administrator
Reclamation	U.S Department of the Interior, Bureau of Reclamation
ROD	Record of Decision
RWA	Recovered Water Account
Secretary	Secretary of the U.S. Department of the Interior
Settlement	Stipulation of Settlement
SJRRP	San Joaquin River Restoration Program
SR	State Route
State	State of California
SWP	State Water Project
SWRCB	State Water Resources Control Board
TAC	Technical Advisory Committee
TAF	thousand acre-feet
USFWS	U.S. Fish and Wildlife Service
VAMP	Vernalis Adaptive Management Program

1.0 Introduction

The San Joaquin River Restoration Program (SJRRP) was established in late 2006 to implement a 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), have prepared this joint Draft Program Environmental Impact Statement/Report (PEIS/R) to implement the Settlement. Federal authorization for implementing the Settlement is provided in the San Joaquin River Restoration Settlement Act (Act) (Public Law 111-11) (Appendix B).

Authority for combined Federal and State documents is provided in Title 40, Code of Federal Regulations (CFR), Sections 1502.25, 1506.2, and 1506.4 (Council on Environmental Quality's Regulations for Implementing NEPA (CEQ Regulations)) and California Code of Regulations (CCR) Title 14, Division 6, Chapter 3 (State CEQA Guidelines), Section 15222 (Preparation of Joint Documents). This document also was prepared consistent with U.S. Department of the Interior regulations specified in 43 CFR, Part 46 (U.S Department of the Interior Implementation of NEPA, Final Rule). This Draft PEIS/R evaluates potential direct, indirect, and cumulative impacts on the environment at a program level that could result from implementing the Settlement consistent with the Act. This Draft PEIS/R also analyzes, at a project level of detail, the potential direct, indirect, and cumulative impacts that could result from implementing certain aspects of the Settlement, including release, conveyance, and recapture of Interim and Restoration flows. In addition, this Draft PEIS/R includes feasible mitigation measures to avoid, minimize, rectify, reduce, or compensate for significant adverse impacts.

1.1 Overview of the 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 Authority (FWA), 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 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. 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 are experimental flows that began in 2009 and will continue until full Restoration Flows are initiated, with the purposed of collecting relevant data concerning flows, temperatures, fish needs, seepage losses, recirculation, recapture, and reuse. To achieve the Water Management Goal, the Settlement calls for recirculation, recapture, reuse, exchange, or transfer of the Interim and Restoration flows to reduce or avoid impacts to water deliveries to all of the Friant Division long-term contractors caused by the Interim and Restoration flows. In addition, the Settlement establishes a Recovered Water Account (RWA) and recovered water program to make water available to all of the Friant Division long-term contractors who provide water to meet Interim or Restoration flows to reduce or avoid the impact of the Interim and Restoration flows on such contractors. Interim and Restoration flows are described in greater detail in Chapter 2.0, "Description of Alternatives."

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. Table 1-1 summarizes the level of analysis provided in this Draft PEIS/R for actions identified in key Settlement paragraphs.

1.1.1 Responsibilities of the Lead Agencies, Responsible Agency, and Implementing Agencies

Reclamation is the lead NEPA agency and DWR is the lead CEQA agency in preparing this Draft PEIS/R. The project-level actions addressed in the PEIS/R include actions to be undertaken by Reclamation, and the effects of these actions are the sole responsibility of Reclamation. DWR serves as the CEQA lead agency for the entire SJRRP, although DWR is not taking any discretionary action for the project-level actions analyzed in this Draft PEIS/R. The SWRCB is the only State agency expected to take a discretionary action, in the form of a water rights approval related to the release and conveyance of Interim and Restoration Flows. It is anticipated that the SWRCB would use this PEIS/R in support of that decision as a CEQA Responsible Agency. In the future, it is expected

that DWR, and other State agencies, will complete project-level CEQA review in support of discretionary actions to implement some of the actions addressed at a program-level in the Final PEIS/R.

To implement the project-level actions, Reclamation would require a modified water rights permit from the SWRCB. Under CEQA, the SWRCB is a Responsible Agency insofar as it has a limited role related to the project-level actions analyzed in this Draft PEIS/R. In order to allow the SWRCB to take its action as a Responsible Agency, which involves making findings that the agency has "considered" the EIR (see State CEQA Guidelines Section 15096(f)), DWR as the CEQA Lead Agency will be required to certify the PEIS/R as meeting CEQA requirements; adopt Findings of Fact, a Statement of Overriding Considerations if needed, and a Mitigation Monitoring and Reporting Program; approve the program; and file a Notice of Determination. As the CEQA Lead Agency for the PEIS/R, DWR has prepared an EIR that provides sufficient project-level information to allow the SWRCB, as a Responsible Agency, to (1) consider the environmental effects of the project-level actions; (2) mitigate or avoid environmental effects of those parts of the project over which those agencies have discretionary authority; and (3) make findings, required by CEQA Guidelines Section 15091, that its decision-making body reviewed and considered the project-level environmental effects presented in the PEIS/R. As a Responsible Agency, if the SWRCB decides to take action to approve its portion of the project, the SWRCB must approve feasible mitigation measures that would reduce the magnitude of or avoid any significant impacts.

The Implementing Agencies, as previously mentioned, include Reclamation; U.S. Fish and Wildlife Service; National Marine Fisheries Service; California Department of Water Resources; and California Department of Fish and Game. The Settlement identifies the need for the involvement of the Secretary through Reclamation as the lead Federal agency responsible for implementation, and through U.S. Fish and Wildlife Service (USFWS) as the lead Federal agency responsible for reintroduction of spring-run and fall-run Chinook salmon. The Settlement also identifies the Secretary of the U.S. Department of Commerce, through National Marine Fisheries Service (NMFS), as a necessary participant to allow for permitting the reintroduction of spring-run Chinook salmon. The Act authorizes and directs the Secretary to implement the Settlement and appropriates funds for implementation. Implementation of the Settlement also requires involvement of the State's Natural Resources Agency through DWR and California Department of Fish and Game (DFG). Consistent with a Memorandum of Understanding (MOU) between the Settling Parties and the State, the California Natural Resources Agency will play a major role in funding and implementing actions called for in the Settlement and in the Act. DWR will assist in planning, designing, and constructing the physical improvements identified in the Settlement, including projects related to flood protection, levee relocation, and modifications to and maintenance of channel facilities. DFG will provide technical assistance on actions related to the release of Interim and Restoration flows and the reintroduction and monitoring of fish, and planning, designing, and constructing facilities to provide fish passage.

1.1.1 San Joaquin River Restoration Program

The SJRRP comprises several Federal and State of California (State) agencies responsible for implementing the Settlement. Implementing Agencies include Reclamation; U.S. Fish and Wildlife Service; National Marine Fisheries Service; California Department of Water Resources; and California Department of Fish and Game. Table 1-1 shows milestone dates recommended in the Settlement. The Implementing Agencies are committed to attaining these milestones, as demonstrated by the release of Interim Flows beginning in October 2009; however, these dates may change, pending completion of compliance, coordination, consultation, data collection, and related efforts. Reclamation and DWR initiated the NEPA and CEQA processes in August 2007 to analyze implementation of the Settlement. As mentioned, Reclamation is the lead NEPA agency and DWR is the lead CEQA agency in preparing this Draft PEIS/R.

Table 1-1.
Key Settlement Milestones

Date	Milestone[1]	Status
October 2009	• Initiate Interim Flows and Monitoring Program	Completed
September 2010	• USFWS submits a completed permit application to NMFS for reintroduction of spring-run Chinook salmon	Completed
April 2012	• NMFS issues a decision on the permit application for reintroduction of spring-run Chinook salmon	Future
December 2012	• Reintroduce spring-run and fall-run Chinook salmon, if permitted by NMFS	Future
December 2013	• Complete Phase 1 improvements identified in the Settlement • Secretary of the Interior, in consultation with NRDC and FWA, develops operational guidelines	Future
January 2014	• Initiate full Restoration Flows	Future
December 2016	• Complete Phase 2 improvements identified in the Settlement	Future
December 2024	• Secretary of Commerce reports to Congress on the progress made in reintroducing spring-run and fall-run Chinook salmon and discusses plans for future implementation of the Settlement	Future
December 2025	• Review and revise Restoration Flows, if necessary	Future
January – July 2026	• Any party to the Settlement may file a motion to request an increase, decrease, or material change in the quantity and/or timing of Restoration Flows	Future

Note:
[1] These milestones are set forth in the Settlement.

Key:
FWA = Friant Water Authority
NMFS = National Marine Fisheries Service
NRDC = Natural Resources Defense Council
Settlement = Stipulation of Settlement
USFWS = U.S. Fish and Wildlife Service

In addition to the Implementing Agencies, the Settlement stipulates the establishment of a Technical Advisory Committee, comprising six members appointed by NRDC and FWA. The Settlement calls for the establishment of a Restoration Administrator (RA), appointed by NRDC and FWA, to facilitate the Technical Advisory Committee and provide specific recommendations to the Secretary in coordination with the Technical Advisory Committee. The RA's duties are defined in the Settlement, and include making recommendations to the Secretary on the release of Interim and Restoration flows. The RA is also responsible for consulting with the Secretary on implementing actions under Paragraph 11 of the Settlement, and for identifying and recommending additional actions under Paragraph 12 of the Settlement. In addition, the RA is responsible for consulting with the Secretary on the reintroduction of Chinook salmon under Paragraph 14 of the Settlement. The RA's recommendations would be taken into consideration by the Secretary in making decisions or taking specific actions to be implemented under the Settlement.

1.2 Purpose of This Document

This Plan Formulation Appendix describes the development of alternatives evaluated in the PEIS/R. This Plan Formulation Appendix expands on information presented in the *Initial Program Alternatives Report* (IPAR), completed June 2008 (SJRRP), which presented initial program alternatives. This Plan Formulation Appendix refines the initial program alternatives presented in the IPAR into a set of alternatives for analysis in the PEIS/R. Alternatives described in the Plan Formulation Appendix were formulated based on results of technical studies, and input received from the Settling Parties, other stakeholders, and the public since completion of the IPAR.

1.3 Purpose, Need, and Objectives of the SJRRP

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 CEQA Guidelines require a clearly written statement of objectives, including the underlying purpose of a project (Section 15124(b)).

The purpose of the proposed action is to implement the Settlement consistent with the Act. The Act authorizes and directs the Secretary to implement the Settlement.

The Settlement specifies the need, which requires changes to the operation of Friant Dam in support of achieving the Restoration Goal while reducing or avoiding adverse impacts to Friant Division long-term contractors' water deliveries caused by releasing Interim or Restoration flows in support of achieving the Water Management Goal. The Implementing Agencies identified several objectives of the proposed action:

- Release Interim Flows from Friant Dam in accordance with Settlement Paragraph 15.
- Release Restoration Flows from Friant Dam in accordance with Settlement Paragraph 13.
- Implement channel and structure modifications in accordance with Settlement Paragraph 11.
- Implement additional modifications to meet the Restoration Goal, as described in Settlement Paragraph 12.
- Reintroduce spring-run and fall-run Chinook salmon to the San Joaquin River below Friant Dam, in accordance with Settlement Paragraph 14.
- Develop and implement a plan to recirculate, recapture, reuse, exchange, or transfer water released for Restoration Flows in accordance with criteria identified in Settlement Paragraph 16(a).
- Establish an RWA that would account for reductions in water supply deliveries to Friant Division long-term contractors resulting from the release of Interim and Restoration flows, and make water available, at $10 an acre-foot, to Friant Division long-term contractors who have experienced water supply reductions resulting from the release of Interim or Restoration flows, in accordance with Settlement Paragraph 16(b).
- Develop and implement monitoring and management plans to guide implementation of the Settlement, including the actions listed in the preceding bullets, in accordance with the Settlement and the Act.

The purpose and objectives respond to a need to increase water releases from Friant Dam to support achieving the Restoration Goal while implementing a plan for recirculation, recapture, reuse, exchange or transfer of the Interim and Restoration flows for the purpose of reducing or avoiding adverse impacts to water deliveries to the Friant Division long-term contractors caused by releasing Interim and Restoration flows.

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

Over the past two centuries, the natural state of the San Joaquin River was dramatically transformed in response to rapid development of water resources. In the late 1880s, large areas of valley floor lands were drained and put to productive agricultural use, 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 1945, Reclamation completed construction of Friant Dam on the San Joaquin River, an initial feature of the Central Valley Project (CVP). Friant Dam was designed to divert most of the San Joaquin River water supplies to about 1 million acres of highly productive farmland along the eastern portion of the San Joaquin Valley. Although Chinook salmon populations were already in decline before construction of Friant Dam, operation of the dam ceased flow in some portions of the river, which ultimately led to the extirpation of Chinook salmon runs in the San Joaquin River upstream from its confluence with the Merced River. Through the SJRRP, Reclamation and DWR are developing actions to restore and maintain fish populations in "good condition" in the mainstem San Joaquin River below Friant Dam to the confluence of the Merced River, including naturally reproducing and self-sustaining populations of Chinook salmon and other fish. The SJRRP also includes tools 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.

1.4 NEPA and CEQA Requirements for Development of Alternatives

The purpose of including alternatives in a PEIS/R is to offer a clear basis for choice by decision-makers and the public on whether and how to proceed with a proposed action. In the case of the SJRRP, the PEIS/R evaluates alternative approaches to implement the provisions of the Settlement, but does not evaluate alternatives to the Settlement other than the required No-Action Alternative. The Settlement identified specific actions to be implemented in achieving the Restoration and Water Management goals. The action alternatives under consideration were formulated to feasibly accomplish most of the primary objectives of the SJRPP as discussed in Chapter 1.0 "Introduction" of the PEIS/R. The action alternatives include features that could avoid or substantially lessen one or more significant effects.

The CEQ regulations and the State CEQA Guidelines describe what is required for an alternatives evaluation in an EIS and EIR, respectively. These requirements are summarized below.

1.4.1 NEPA Requirements

The NEPA CEQ Regulations (40 CFR 1502.14) require that an EIS include the following:

- Objective evaluation of reasonable alternatives
- Identification of the alternatives considered but eliminated from detailed study, along with a brief discussion of the reasons that these alternatives were eliminated
- Information that would allow reviewers to evaluate the comparative merits of the proposed action (i.e., proposed project) and alternatives
- Consideration of the no-action alternative

- Identification of the agency's preferred alternative, if any
- Appropriate mitigation measures not already included in the proposed action or alternatives

NEPA requires the analysis of the proposed action and all alternatives considered at a substantial level of detail. CEQ Regulations (40 CFR 1502.14) require agencies to rigorously explore and objectively evaluate all reasonable alternatives and to devote substantial treatment to each alternative considered, including the proposed action. All alternatives considered must be evaluated compared to the No-Action Alternative (future without project). As defined in 40 CFR Part 46.110, Reclamation is ultimately responsible for ensuring that consensus-based alternatives, if any, are fully consistent with NEPA CEQ regulations, and applicable statutory and regulatory provisions.

1.4.2 CEQA Requirements

Section 15126.6(a) of the State CEQA Guidelines requires that an EIR does the following:

- Describe a range of reasonable alternatives to a proposed project, or to the location of the project, that would feasibly attain most of the basic project objectives but would avoid or substantially lessen any of the significant effects of the project

- Evaluate the comparative merits of the alternatives

An EIR need not consider every conceivable alternative to a proposed project but must consider a range of reasonable potentially feasible alternatives that would foster informed decision-making and public participation.

The range of alternatives required to be evaluated in an EIR is governed by a "rule of reason" that requires the EIR to set forth only those alternatives necessary to permit a reasoned choice. The EIR need examine in detail only those alternatives that the lead agency determines could feasibly attain most of the basic project objectives, taking into account factors that include site suitability; economic viability; availability of infrastructure; general plan consistency; other plans or regulatory limitations; jurisdictional boundaries; and whether the proponent can reasonably acquire, control, or otherwise have access to the alternative site (State CEQA Guidelines Section 15126.6(f)). CEQA does not require the alternatives to be evaluated at the same level of detail as the proposed project.

The State CEQA Guidelines recommend that an EIR should briefly describe the rationale for selecting the alternatives to be discussed, identify any alternatives that were considered by the lead agency but were eliminated as infeasible, and briefly explain the reasons underlying the lead agency's determination (State CEQA Guidelines Section 15126.6(c)).

An EIR must also evaluate a "no-project" alternative, which represents "what would be reasonably expected to occur in the foreseeable future if the project were not approved, based on current plans and consistent with available infrastructure and community services" (State CEQA Guidelines Section 15126.6(e)(2)).

1.5 Overview of Program Alternatives

This Draft PEIS/R evaluates a No-Action Alternative and six action alternatives to implement the Settlement. Each action alternative includes the actions called for in the Settlement. The action alternatives differ in two program-level ways:

- **Additional Restoration Actions –** The maximum peak Restoration Flow that would be routed through Reach 4B1 (at least 475 cubic feet per second (cfs) or at least 4,500 cfs), as shown in Table 2-1 and Figure 1-1.

- **Additional Water Management Actions on the San Joaquin River –** How Restoration Flows would be recaptured (Delta only, or Delta plus existing San Joaquin River diversions with or without new infrastructure to increase pumping capacity below the Merced River), as shown in Table 2-1 and in Figure 1-2.

Table 2-1.
Actions Included Under Action Alternatives

Level of NEPA/CEQA Compliance	Actions		Action Alternative					
			A1	A2	B1	B2	C1	C2
Project-Level	Reoperate Friant Dam and downstream flow control structures to route Interim and Restoration flows		✓	✓	✓	✓	✓	✓
	Recapture Interim and Restoration flows in the Restoration Area		✓	✓	✓	✓	✓	✓
	Recapture Interim and Restoration flows at existing CVP and SWP facilities in the Delta		✓	✓	✓	✓	✓	✓
Program-Level	Common Restoration actions[1]		✓	✓	✓	✓	✓	✓
	Actions in Reach 4B1 to provide at least:	475 cfs capacity	✓	✓	✓	✓	✓	✓
		4,500 cfs capacity with integrated floodplain habitat		✓		✓		✓
	Recapture Interim and Restoration flows on the San Joaquin River downstream from the Merced River at:	Existing facilities on the San Joaquin River			✓	✓	✓	✓
		New pumping infrastructure on the San Joaquin River					✓	✓
	Recirculation of recaptured Interim and Restoration flows		✓	✓	✓	✓	✓	✓

Note:
[1] Common Restoration actions are physical actions to achieve the Restoration Goal that are common to all action alternatives and are addressed at a program level of detail.

Key:
CEQA = California Environmental Quality Act
cfs = cubic feet per second
CVP = Central Valley Project
Delta = Sacramento-San Joaquin Delta
NEPA = National Environmental Policy Act
PEIS/R = Program Environmental Impact Statement/Report
SWP = State Water Project

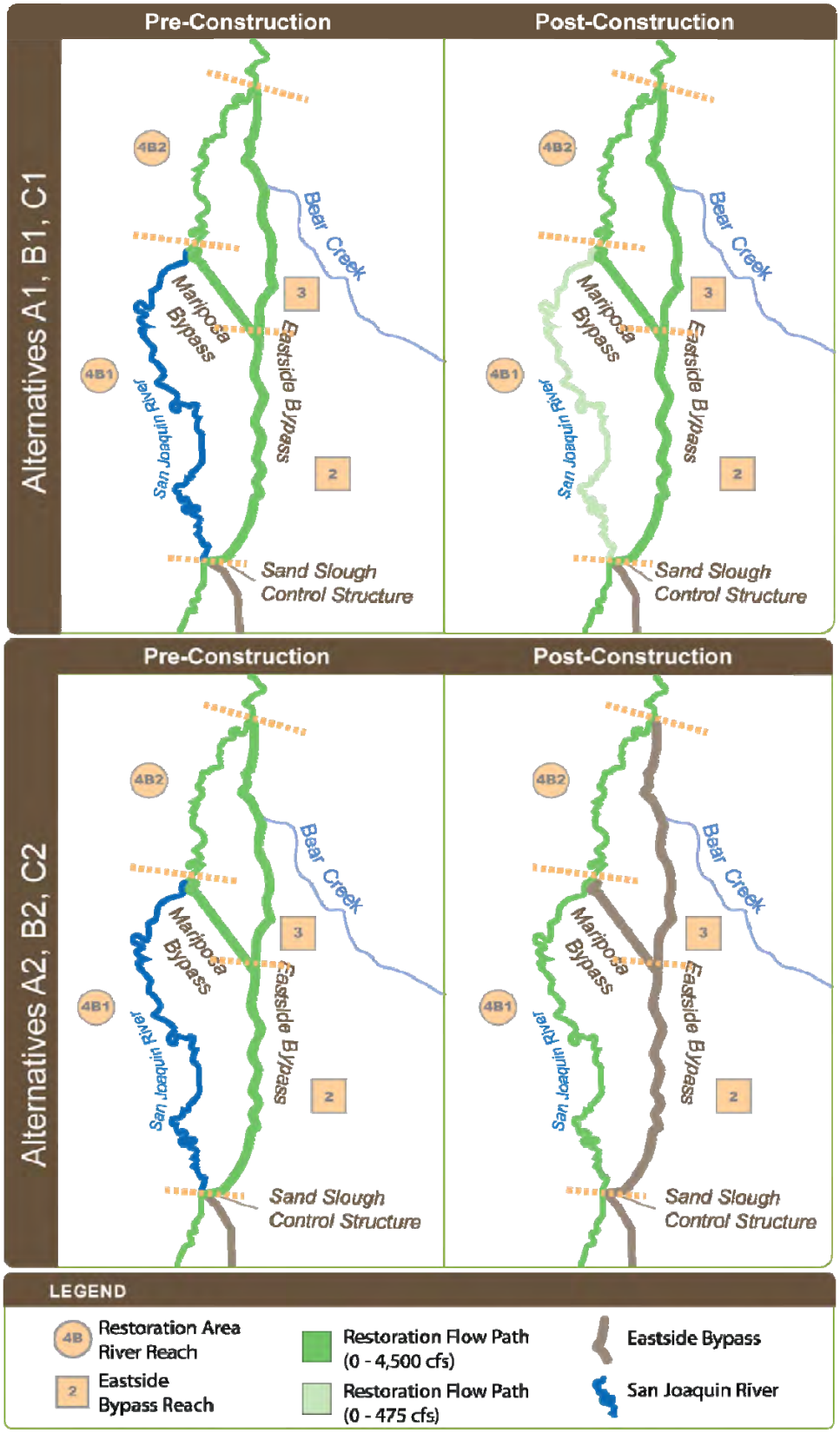
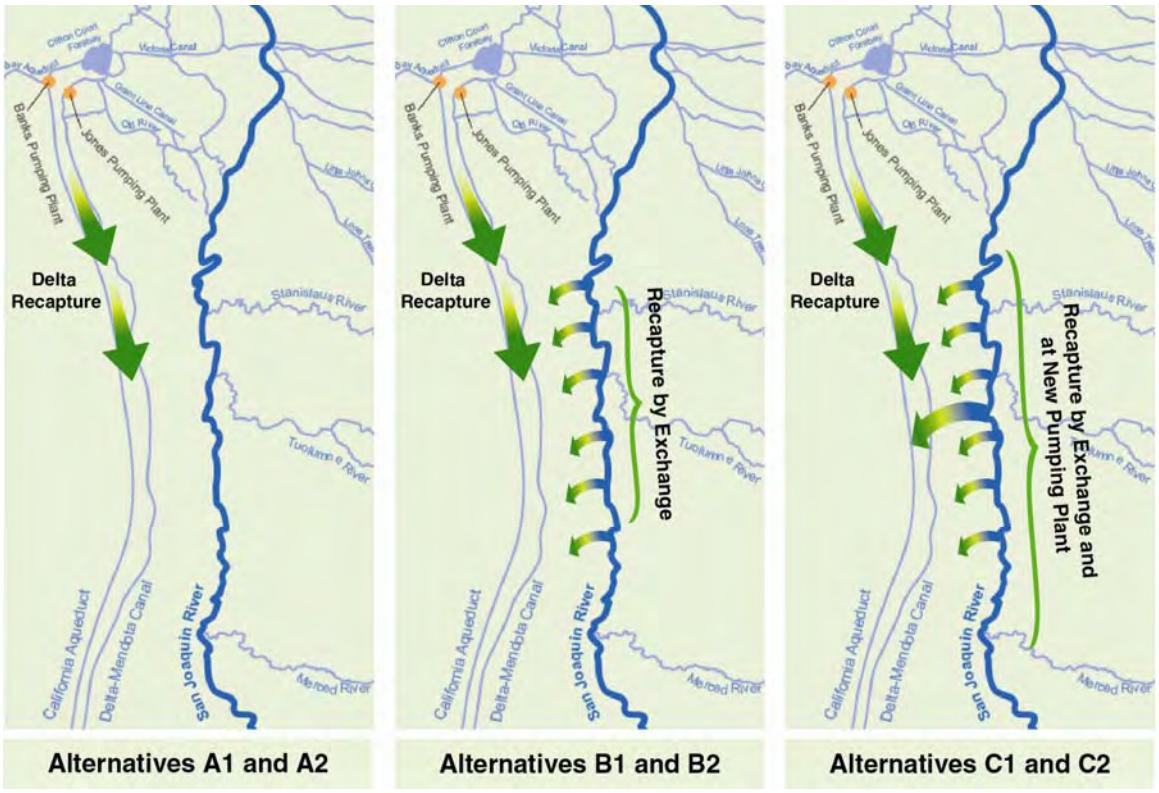


Figure 1-1.
Flow Routing in Reach 4B and Bypass System Under Action Alternatives



Note: Water recapture approaches shown do not encompass potential recapture of Interim and Restoration flows at existing facilities within the Restoration Area.

Figure 1-2.
Water Recapture Approaches Downstream from Restoration Area Included in Action Alternatives

Program alternatives include the following:

- **No-Action Alternative –** Under the No-Action Alternative (No-Project Alternative under CEQA), the Settlement would not be implemented. The No-Action Alternative includes projected conditions as they would exist in the study area at the end of the PEIS/R planning horizon (2030), including those projects and programs considered reasonably foreseeable by that time.

- **Alternative A1: Reach 4B1 at 475 cfs, Delta Recapture –** Alternative A1 includes reoperation of Friant Dam, and a range of actions to achieve the Restoration and Water Management goals. Under Alternative A1, Reach 4B1 would convey at least 475 cfs, and the Eastside and Mariposa bypasses would convey any remaining Interim and Restoration flows. Alternative A1 includes the potential for recapture of Interim and Restoration flows in the Restoration Area and Interim and Restoration flows in the Delta using existing diversion facilities, and the potential for recirculation of all recaptured Interim and Restoration flows. A Physical Monitoring and Management Plan is included in Alternative A1 to provide guidelines for observing and adjusting to changes in conditions regarding flow, seepage, channel capacity, propagation of native vegetation, and suitability of spawning gravel. Alternative A1 also includes a conservation strategy

consisting of management actions necessary to provide a net increase in the extent and quality of riparian and wetland habitats in the Restoration Area, to avoid reducing the long-term viability of sensitive species, and to be consistent with adopted conservation plans.

- **Alternative A2: Reach 4B1 at 4,500 cfs, Delta Recapture** – Alternative A2 includes the same Restoration and Water Management actions as Alternative A1, plus additional Restoration actions to increase Reach 4B1 channel capacity to at least 4,500 cfs, with integrated floodplain habitat. Under this alternative, the Eastside Bypass would not convey Interim or Restoration flows after completion of Reach 4B1 channel modifications.

- **Alternative B1: Reach 4B1 at 475 cfs, San Joaquin River Recapture –** Alternative B1 includes the same Restoration and Water Management actions as Alternative A1, plus additional Water Management actions for the recapture of Interim and Restoration flows in the San Joaquin River below the confluence of the Merced River, using existing facilities with potential in-district modifications.

- **Alternative B2: Reach 4B1 at 4,500 cfs, San Joaquin River Recapture** – Alternative B2 includes the same Restoration and Water Management actions as Alternative B1, plus the additional Restoration actions included in Alternative A2 to increase Reach 4B1 channel capacity to at least 4,500 cfs, with integrated floodplain habitat. Under this alternative, the Eastside Bypass would not convey Interim or Restoration flows after completion of Reach 4B1 channel modifications.

- **Alternative C1: Reach 4B1 at 475 cfs, New Pumping Infrastructure Recapture –** Alternative C1 includes the same Restoration and Water Management actions as Alternative B1, plus additional Water Management actions for recapture of Interim and Restoration flows, through new infrastructure, to increase pumping capacity on the San Joaquin River below the confluence of the Merced River.

- **Alternative C2: Reach 4B1 at 4,500 cfs, New Pumping Infrastructure Recapture –** Alternative C2 includes the same Restoration and Water Management actions as Alternative C1, plus the additional Restoration actions included in Alternative A2 to increase Reach 4B1 channel capacity to at least 4,500 cfs, with integrated floodplain habitat. Under this alternative, the Eastside Bypass would not convey Interim or Restoration flows after completion of Reach 4B1 channel modifications.

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2.0 Study Area Setting

The study area for this Draft PEIS/R, as shown in Figure 2-1, includes areas that may be affected directly, indirectly, or cumulatively by implementing program alternatives. The study area has been broadly defined to ensure evaluation of potential effects within five geographic subareas:

- San Joaquin River upstream from Friant Dam, including Millerton Lake
- San Joaquin River from Friant Dam to the Merced River confluence (Restoration Area, which includes Reaches 1 through 5 and the flood bypasses, as shown on Figure 1-2)
- San Joaquin River from the Merced River to the Delta
- Delta
- CVP/SWP water service areas, including the Friant Division of the CVP

Operational impacts would result in all geographic subareas under all alternatives. Construction-related impacts would result in the Restoration Area under all action alternatives and in the San Joaquin River from the Merced River to the Delta under Alternatives B1, B2, C1, and C2 only. Construction-related impacts would not result in other geographic subareas. The geographic subareas are described briefly below.

2.1 San Joaquin River Upstream from Friant Dam

The San Joaquin River originates in the Sierra Nevada at an elevation of 12,000 feet above mean sea level (msl) (North American Vertical Datum (NAVD) 1988) (elevation 12,000). Millerton Lake, formed by Friant Dam, is the largest reservoir on the San Joaquin River. Wildlife habitat around the lake is fairly sparse, and the lake is surrounded by low hills. Inflow to Millerton Lake consists primarily of upper San Joaquin River flows, and is influenced by the operation of several upstream hydropower generation projects. Other inflows to Millerton Lake include local runoff, and Millerton Lake typically fills during late spring and early summer, when San Joaquin River flows are high because of snowmelt in the upper watershed. Friant Dam diverts much of the water from the San Joaquin River to contractors within the CVP Friant Division water service area. Annual water allocations and release schedules are developed with the intent of drawing reservoir storage to minimum levels by the end of September. The operation of Friant Dam changes storage levels in Millerton Lake, which in turn can influence resources affected by storage conditions and lake levels.

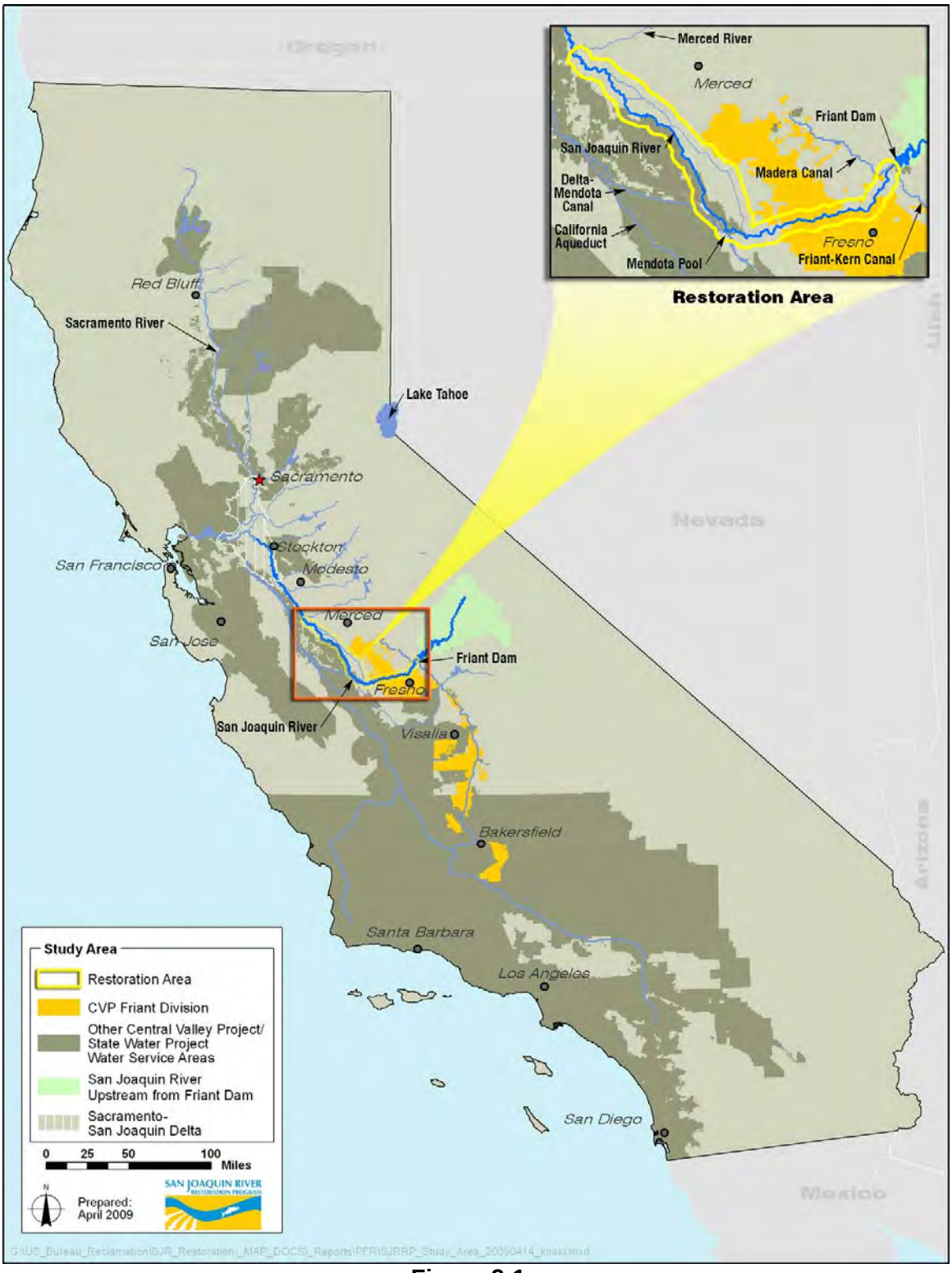

Figure 2-1.
San Joaquin River Restoration Program Study Area

2.2 San Joaquin River from Friant Dam to Merced River

SJRRP restoration activities focus on this 150-mile reach of the San Joaquin River, termed the Restoration Area. The river and flood bypasses within the Restoration Area are described as a series of physically and operationally distinct reaches, as defined in Table 2-2 and shown in Figure 2-2.

Table 2-2.
San Joaquin River Reaches and Flood Bypasses in the Restoration Area

River or Bypass	Reach	Head of Reach or Bypass	Downstream End of Reach or Bypass
San Joaquin River	1A	Friant Dam	State Route 99
	1B	State Route 99	Gravelly Ford
	2A	Gravelly Ford	Chowchilla Bypass Bifurcation Structure
	2B	Chowchilla Bypass Bifurcation Structure	Mendota Dam
	3	Mendota Dam	Sack Dam
	4A	Sack Dam	Sand Slough Control Structure
	4B1	Sand Slough Control Structure	Confluence with Mariposa Bypass
	4B2	Confluence with Mariposa Bypass	Confluence with Bear Creek and Eastside Bypass
	5	Confluence with Bear Creek and Eastside Bypass	Confluence with Merced River
Chowchilla Bypass		Chowchilla Bypass Bifurcation Structure	Confluence with Ash Slough and Eastside Bypass
Eastside Bypass	1	Confluence with Ash Slough and Chowchilla Bypass	Confluence with Sand Slough Bypass
	2	Confluence with Sand Slough Bypass	Mariposa Bypass Bifurcation Structure and Eastside Bypass Bifurcation Structure
	3	Eastside Bypass Bifurcation Structure	Confluence with Bear Creek and San Joaquin River
Sand Slough Bypass		Sand Slough Control Structure	Eastside Bypass
Mariposa Bypass		Mariposa Bypass Bifurcation Structure	Confluence with San Joaquin River

Each reach in the Restoration Area is summarized in the following subsections. Current flows and channel capacity, geomorphologic characteristics, vegetation, and other characteristics related to fisheries habitat in the Restoration Area are described to provide background context for features that could be affected by actions included in the program alternatives.

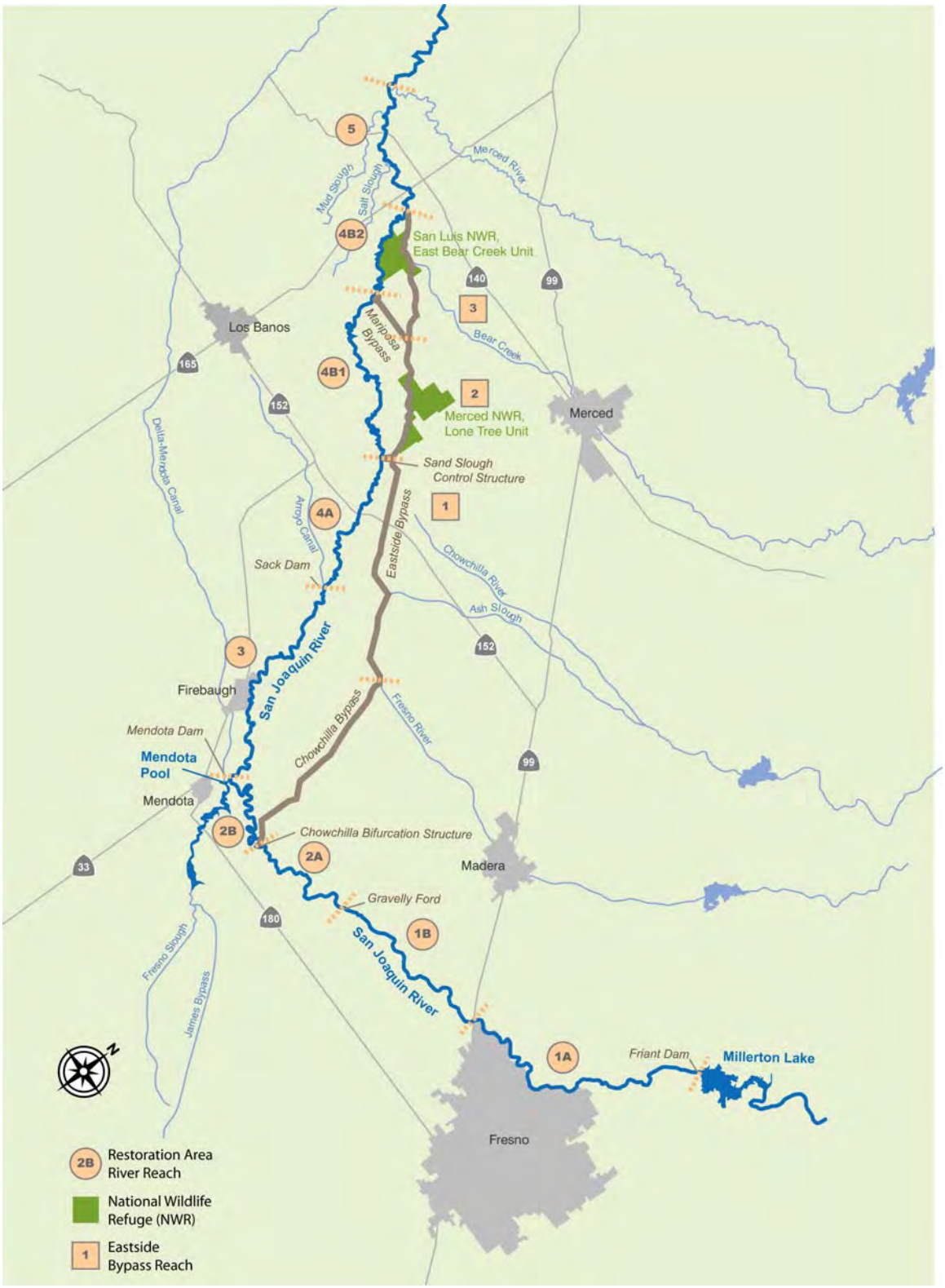

Figure 2-2.
San Joaquin River Reaches and Flood Bypasses in the Restoration Area

2.2.1 Reach 1 – Friant Dam to Gravelly Ford

Reach 1 begins at Friant Dam and continues approximately 37 miles downstream to Gravelly Ford. For the purpose of the SJRRP, Reach 1 has been divided into two subreaches, as shown in Figure 2-2:

- Reach 1A extends from Friant Dam to State Route (SR) 99
- Reach 1B begins at SR 99 and extends downstream to Gravelly Ford

Reach 1 currently conveys flows released from Friant Dam to numerous downstream water right and contract diversion points. Releases from Friant Dam maintain a continuous flow in Reach 1, from 180 to 250 cubic feet per second (cfs) during summer and 40 to 100 cfs during winter (CDEC 2008). Under normal (nonflood control) operations, remaining flows released from Friant Dam for water diversion typically dissipate because of seepage to groundwater near Gravelly Ford. Releases from Friant Dam for riparian water users within Reach 1 average about 117 thousand acre-feet (TAF) of water per year.

Reach 1 is an incised, gravel-bedded channel confined between bluffs and terraces 750 feet to 6,750 feet apart. Several locations in Reach 1 have debris in the channel, such as concrete riprap or bridge remnants, wood pilings from abandoned crossings, and culverts from former crossings. In-channel debris may contain materials that are harmful to fish. Two tributaries, Cottonwood Creek and Dry Creek, and a drainage channel contribute flow and sediment to Reach 1A. Gravel replenishment in Reach 1 is limited to these and other small tributary sources downstream from Friant Dam. In addition, extensive mining of the substrate has degraded native fish habitat in Reach 1. Reach 1 is directly connected to 190 acres of sand and aggregate mining pits, with an additional 1,170 acres of pits in the surrounding floodplain (McBain and Trush 2002). These pits impede coarse sediment routing, increase river water temperatures and evaporation, increase habitat for nonnative predatory fish species (EA Engineering 1991), and attenuate flows. Reach 1A contains most of the gravel mining pits, with some sites in the upstream portion of Reach 1B. Under steady-state conditions, flow does not reach the Chowchilla Bypass Bifurcation Structure when discharge at Gravelly Ford is less than 75 cfs (McBain and Trush 2002).

Side channels occur in Reach 1. The side channels vary widely in their potential to contribute to, or harm, reestablishment of a salmon fishery in the river because of water temperature, predator, and food conditions in each channel. Additional conditions in Reach 1 that may affect restoration include several bridge crossings and unscreened riparian river diversions, which occur throughout the Restoration Area (DFG 2005).

Fish species currently inhabiting Reach 1 include native species such as rainbow trout, Sacramento sucker, Sacramento pikeminnow, sculpin species, and others. Introduced species in Reach 1 include largemouth bass, carp, and spotted bass, among others (DFG 2007). The San Joaquin Hatchery is located in Reach 1. This hatchery produces rainbow trout, which are planted in lakes and streams in Fresno, Madera, Tulare, Mariposa, and Kern counties (DFG 2009).

2.2.2 Reach 2 – Gravelly Ford to Mendota Dam

Reach 2, as shown in Figure 2-2, begins at Gravelly Ford and extends approximately 24 miles downstream to the Mendota Pool. For the purpose of the SJRRP, Reach 2 is subdivided into two subreaches:

- Reach 2A begins at Gravelly Ford and extends downstream to the Chowchilla Bypass Bifurcation Structure
- Reach 2B extends from the bifurcation structure downstream to Mendota Dam

Reach 2A is approximately 13 miles long, with a sandy channel bottom that is subject to seepage losses. Reach 2A has a wide, flat, and shifting channel. Federal/State flood control project levees for the San Joaquin River, spaced 500 feet to 2,600 feet apart, confine Reach 2A, except above approximately 2 miles at the upstream end of the reach, which has no levees. Nonproject interior levees in Reach 2A are located between the exterior project levees.

The Chowchilla Bypass Bifurcation Structure, a component of the Lower San Joaquin River Flood Control Project, diverts flood flows from the mainstem San Joaquin River into the Chowchilla Bypass.

Reach 2B is about 11 miles long and extends from the Chowchilla Bypass Bifurcation Structure downstream to Mendota Dam, as shown in Figure 2-2. Reach 2B is a sandy channel and, with the exception of backwater in the lower portion from the Mendota Pool, this reach is dry under normal conditions. Nonproject exterior levees, spaced 275 feet to about 2,500 feet apart, confine most of this reach. Interior levees that protect cropland are present near the downstream end of the reach. Fresno Slough, also known as the James Bypass, conveys flood flows in some years from the Kings River system in the Tulare Basin to the Mendota Pool. Pine Flat Dam regulates these flows. Reach 2B was originally designed for a conveyance capacity of 2,500 cfs, but significant seepage has been observed at flows above 1,300 cfs (RMC 2007). The Chowchilla Bypass Bifurcation Structure operating rules limit flows to 2,500 cfs in Reach 2B when upstream river flows are less than 8,000 cfs, with flows increasing to 6,500 cfs when the discharge in the upstream river is up to 12,000 cfs (McBain and Trush 2002). However, current flood operations at Friant Dam and the Chowchilla Bypass Bifurcation Structure are based on the reduced river channel capacity of approximately 1,300 cfs.

Mendota Dam, at the downstream end of Reach 2B, impounds water for diversion from the Mendota Pool. Several conveyance facilities are present at the Mendota Pool, including the Helm Ditch (10 cfs), Main Canal (1,500 cfs), Outside Canal (300 cfs), Firebaugh Canal Water District Canal (300 cfs), Fresno Slough (300 cfs), Delta-Mendota Canal (DMC) (2,600 cfs), James Bypass (4,500 cfs), Columbia Canal (200 cfs), and several smaller diversions. Reach 2 also contains a low-flow road crossing and several other unscreened diversions.

Fish species occurring in Reach 2 are confined during typical flow conditions to small upstream portions of Reach 2 and to the Mendota Pool, with restricted fish migration between these habitats. The only native species recently found in this reach is hitch (Jones & Stokes 1987, as cited in DFG 2007). The introduced species population is similar in composition to that of Reach 1, with a few additional species, including striped bass (DFG 2007).

2.2.3 Reach 3 – Mendota Dam to Sack Dam

Reach 3 begins at Mendota Dam and extends approximately 23 miles downstream to Sack Dam, as shown in Figure 2-2. Reach 3 conveys flows of up to 800 cfs from the Mendota Pool for diversion to the Arroyo Canal at Sack Dam, maintaining flow year-round in a meandering channel with a sandy bed. Nonproject exterior levees spaced about 315 feet to 4,100 feet apart confine Reach 3, with smaller interior levees or berms present at some locations to protect private agricultural land. Under high-flow conditions, the San Joaquin River flows over interior levees in some areas, creating connected side channels. In 2006, the U.S. Geological Survey (USGS) recorded a mean maximum daily discharge of 4,590 cfs in this reach; DWR reported that seepage occurred on lands in and adjacent to the floodway at this time.

Native fish species occurring in Reach 3 include prickly sculpin, hitch, Sacramento blackfish, and tule perch (Saiki 1984, Brown and Moyle 1993, DFG 2001, Moyle 2002, DFG 2007). Nonnative fish species present in Reach 3 include all those documented in Reaches 1 and 2, as well as inland silverside and red shiner (Saiki 1984, Brown and Moyle 1993, DFG 2001, Moyle 2002, DFG 2007).

2.2.4 Reach 4 – Sack Dam to Eastside Bypass Confluence

Reach 4 is approximately 46 miles long, and is subdivided into distinct subreaches, as shown in Figure 2-2:

- Reach 4A extends from Sack Dam downstream to the Sand Slough Control Structure
- Reach 4B begins at the Sand Slough Control Structure, extends downstream to the confluence with Bear Creek and the Eastside Bypass, and comprises two subreaches:
  - Upstream from the Mariposa Bypass (Reach 4B1)
  - Downstream from the Mariposa Bypass (Reach 4B2)

Reach 4A begins at Sack Dam and extends approximately 13 miles to the San Joaquin River Headgates at the Sand Slough Control Structure. Reach 4B1 is approximately 21 miles long, extending from the San Joaquin River Headgates at the Sand Slough Control Structure to the confluence with the Mariposa Bypass, where flood flows in the bypass system rejoin the mainstem San Joaquin River. Reach 4B2 begins at the confluence of the Mariposa Bypass with the mainstem San Joaquin River, and extends approximately 12 miles to the confluence of the Eastside Bypass with the mainstem San Joaquin River.

Except during high-flow conditions, Reach 4A normally only carries some seepage water from Sack Dam and from adjacent agricultural areas. At the downstream end of Reach 4A, any water in the channel flows into the Eastside Bypass through Sand Slough. Nonproject exterior levees generally confine Reach 4A, with two segments of interior levees. Nonproject exterior levees were constructed for flood protection and extend to canal levees. Interior levees were constructed to protect private lands in the floodplains.

Reach 4B1 begins at the San Joaquin River Headgates and extends to the confluence of the Mariposa Bypass with the mainstem San Joaquin River. Since completion of the San Joaquin River Flood Control Project, no flows have been routed through Reach 4B1. At that time, it was estimated that the capacity of Reach 4B1 was 1,500 cfs. Because flow through this reach has been eliminated (except agricultural return flows and local runoff), and channel maintenance has ceased, dense riparian vegetation has greatly diminished channel capacity. In addition, several road crossings to support local agricultural practices further reduce flow capacity.

Project levees line the channel at the downstream end of Reach 4B1, and flow capacity is affected by inflow conditions downstream from the Mariposa Bypass. Flow capacity within the project levees is reduced when flows occur concurrently in the river and Mariposa Bypass, partly due to backwater effects.

Reach 4B2 begins at the confluence of the Mariposa Bypass with the mainstem San Joaquin River. The San Luis National Wildlife Refuge (NWR) Complex is adjacent to and in the vicinity of Reach 4B2. Reach 4B2 is confined between project levees spaced 900 feet to 3,500 feet apart, and the reach regularly carries agricultural return flows and runoff as well as higher flows entering via the Mariposa Bypass during flood conditions. The design channel capacity is 10,000 cfs. Seepage to adjacent lands has been observed in Reach 4B2 under high-flow conditions.

Several unscreened diversions are present throughout Reach 4. Because Reach 4 is dry much of the time, only a single fish species, inland silverside, has been documented in Reach 4 in the past 25 years (Saiki 1984, DFG 2007).

2.2.5 Reach 5 – Eastside Bypass Confluence to Merced River Confluence

Reach 5, as shown in Figure 2-2, begins at the Eastside Bypass/Bear Creek confluence, and extends approximately 18 miles downstream to the Merced River confluence. Project levees along the west bank confine Reach 5 downstream to the Salt Slough confluence and along the east bank to the Merced River confluence. The design capacity of Reach 5 is 26,000 cfs. This reach receives flows from Mud and Salt sloughs, which convey flows from agricultural and wildlife managements areas.

Great Valley Grasslands State Park is downstream from the Bear Creek confluence with Reach 5. The Kesterson Unit of the San Luis NWR is adjacent to the State Park.

The Hills Ferry Barrier is a seasonally deployed barrier located in Reach 5 just upstream from the Merced River confluence. The barrier is currently operated to prevent fall-run Chinook salmon migrating to the Merced River from straying into the San Joaquin River upstream from the Merced River. Reach 5 also has several unscreened diversions.

Native fish species recently documented in Reach 5 include Sacramento sucker, Sacramento pikeminnow, Sacramento splittail, tule perch, and others. All nonnative species present upstream from Reach 5 are also present in this reach (Saiki 1984, Brown and Moyle 1993, DFG 2001, Moyle 2002, DFG 2007).

2.2.6 Flood Bypasses – Chowchilla, Eastside, Sand Slough, and Mariposa

The Chowchilla, Eastside, and Mariposa bypasses were designed to convey water during high-flow conditions to prevent flooding. Project levees line all of the flood bypass system; no capacity constraints have been identified to reduce channel capacities of the bypass system from design capacity.

The Chowchilla Bypass begins at the Chowchilla Bypass Bifurcation Structure and extends to the confluence of Ash Slough and the Eastside Bypass, as shown in Figure 2-2. The Chowchilla Bypass carries flood flows from Reach 2A and tributaries, including the Fresno River, Berenda Slough, and Ash Slough, to the Eastside Bypass.

The Eastside Bypass extends from the confluence of Ash Slough and the Chowchilla Bypass to the confluence with the mainstem San Joaquin River at the head of Reach 5, as shown in Figure 2-2. The Eastside Bypass is subdivided into three reaches. Eastside Bypass Reach 1 extends from Ash Slough to the Sand Slough Bypass confluence, and receives flows from the Chowchilla River. This reach has a design channel capacity of 17,000 cfs. The Sand Slough Bypass diverts flows from the Sand Slough Control Structure at the downstream end of Reach 4A, to the Eastside Bypass; the Sand Slough Bypass design capacity is 3,000 cfs. Eastside Bypass Reach 2 extends from the Sand Slough Bypass confluence to the Mariposa Bypass Bifurcation Structure and the Eastside Bypass Bifurcation Structure, and has a design channel capacity of 16,500 cfs. Eastside Bypass Reach 3 extends from the Eastside Bypass Bifurcation Structure to the head of Reach 5 and receives flows from Deadman, Owens, and Bear creeks. This reach has a design channel capacity of 13,500 cfs upstream from the confluence of Bear Creek, and 18,500 cfs downstream from the confluence of Bear Creek.

The Mariposa Bypass extends from the Mariposa Bypass Bifurcation Structure to the head of Reach 4B2, as shown in Figure 2-2. The Mariposa Bypass operating rule diverts all flow at the Mariposa Bypass Bifurcation Structure back into the San Joaquin River at discharges of up to 8,500 cfs, the design channel capacity of the Mariposa Bypass. Any higher flows remain in the Eastside Bypass. Actual operations deviate from this rule, with flows of up to about 2,500 cfs staying in the Eastside Bypass, after which approximately one-quarter to one-third of the water is allowed to flow into the Mariposa Bypass (McBain and Trush 2002). A drop structure is located near the downstream end of the Mariposa Bypass and dissipates energy from flows before they enter the mainstem San Joaquin River.

Fish species that may use temporary aquatic habitat in the bypasses have not been studied. However, it is assumed that any species present near the diversion points could be routed into the bypasses along with flood flows.

2.3 San Joaquin River from Merced River to the Delta

The San Joaquin River downstream from the Merced River confluence to the Delta receives inflow from several large rivers, including the Merced, Tuolumne, and Stanislaus rivers. These rivers flow west out of the Sierra Nevada Mountains to the San Joaquin River. The Merced, Tuolumne, and Stanislaus rivers each support fisheries, including fall-run Chinook salmon. The Merced River flows west out of the Sierra Nevada to its confluence with the San Joaquin River at the end of Reach 5. The Tuolumne River flows approximately 150 miles to the San Joaquin River. The Stanislaus River flows into the San Joaquin River just upstream from Vernalis. Several smaller rivers join the San Joaquin River below the Stanislaus River confluence.

Flows in the San Joaquin River below the Merced River confluence to the Delta are controlled in large part by releases from reservoirs, located on the tributary systems, to satisfy contract deliveries, as well as operational constraints such as the Vernalis Adaptive Management Program (VAMP). VAMP, officially initiated in 2000 as part of SWRCB Water Right Decision 1641, is a large-scale, long-term (12-year), experimental/management program designed to identify how salmon survival rates change in response to alterations in San Joaquin River flows and CVP/SWP exports (Reclamation and San Joaquin River Group Authority 1999). The primary objective of VAMP is to implement a pulse flow for a 31-day period in the San Joaquin River at Vernalis during April and May of up to 110 TAF depending on estimated unimpaired flow conditions to temporarily enhance the river's assimilative capacity for salt, thereby improving water quality for fisheries, such as spring-run Chinook salmon.

Fish species presently inhabiting the San Joaquin River from the confluence with the Merced River to the Delta include anadromous salmonids, other native species, and nonnative species. Runs of fall-run Chinook salmon are present in major tributaries, supported in part by hatchery stock in the Merced River. Steelhead are also present in the Stanislaus, Tuolumne, and possibly the Merced river systems below the major dams (McEwan 2001). Native species inhabiting this portion of the study area include Sacramento sucker, Sacramento pikeminnow, Sacramento splittail, tule perch, prickly sculpin, Sacramento blackfish, hardhead, and others (Brown and May 2006). Nonnative fish in the San Joaquin River between the Merced River confluence and the Delta include species present in the Restoration Area, such as inland silverside, black bass species, striped bass, common carp, and others (Brown and May 2006).

2.4 Sacramento-San Joaquin Delta

The Delta is a network of islands and channels at the confluence of the Sacramento and San Joaquin rivers. The Delta has an area of approximately 750,000 acres, and receives runoff from a watershed that includes more than 40 percent of California's land area accounts for approximately 42 percent of the State's annual runoff (Water Education Foundation 1992). Tributaries that directly discharge into the Delta include the Sacramento, San Joaquin, Mokelumne, Cosumnes, and Calaveras rivers. The Delta supplies water for most of California's agricultural production and many urban and industrial communities across the State.

In the Delta, the Federal CVP Harvey O. Banks (Banks) Pumping Plant and SWP C.W. "Bill" Jones (Jones) Pumping Plant move water from the Delta to a system of canals and reservoirs for agriculture, municipal and industrial (M&I), and environmental uses in the San Joaquin Valley; the San Francisco Bay Area (Bay Area), along the central coast; and portions of Southern California. Surface water resources in the Delta are influenced by the interaction of tributary inflows, tides, Delta hydrodynamics, regulatory requirements, and water management actions, such as reservoir releases, in-Delta diversions, and transfers. The Banks and Jones pumping plants are operated according to established guidelines for the CVP and SWP Delta facilities based on endangered fish species affected by pumping.

Additional simulation is being prepared to determine the impacts of the program alternatives under USFWS's 2008 Biological Opinion on the Coordinated Operations of the CVP and SWP (2008 USFWS CVP/SWP Operations BO) and NMFS's 2009 Final Biological and Conference Opinion on the Long-Term Operations of the CVP and SWP (2009 NMFS CVP/SWP Operations BO). The results of this assessment may change the anticipated effects of the alternatives; however, the relative impacts and overall impact mechanisms are not anticipated to change with the results of this assessment. The results of this assessment will be provided in the Final PEIS/R.

The Delta also provides habitat for numerous plant, animal, and fish species, including several threatened or endangered species. The Delta serves as a migration path for all Central Valley anadromous species returning to their natal rivers to spawn; adult Chinook salmon move through the Delta during most months of the year.

2.5 Central Valley Project and State Water Project Water Service Areas

Federal, State, and local water service entities manage water supplies throughout the study area. The following sections describe CVP and SWP service areas and facilities that have the potential to be affected by implementation of program alternatives.

2.5.1 Central Valley Project Friant Division Water Service Areas and Facilities

Reservoir facilities at Millerton Lake are part of the CVP Friant Division, and their operation affects flow in the San Joaquin River. Friant Dam is operated to supply water to agricultural and urban areas in the eastern San Joaquin Valley and to provide flood protection to downstream areas. Water is diverted at Friant Dam and conveyed to Friant Division agricultural and urban water contractors north in the Madera Canal, and south in the Friant-Kern Canal (Figure 2-3).

The CVP Friant Division provides water to over 1 million acres of irrigable land on the east side of the southern San Joaquin Valley, from near the Chowchilla River in the north to the Tehachapi Mountains in the south. More than 90 varieties of crops are grown in the CVP Friant Division water service area with water diverted from the San Joaquin River. Principal features of the CVP Friant Division were completed in the 1940s, including Friant Dam and Millerton Lake, and the Madera and Friant-Kern canals. Current capacity in the Friant-Kern Canal ranges from 5,300 cfs at Millerton Lake to 2,170 cfs at the terminus. The estimated current capacity of the Madera Canal ranges from 1,275 cfs at Millerton Lake to 600 cfs at the terminus.

The CVP Friant Division was designed and is operated to support conjunctive water management. Reclamation employs a two-class system of water allocation to take advantage of water during wetter years, as follows:

- Class 1 contracts, which are based on a firm water supply, are generally assigned to M&I and agricultural water users who have limited access to good quality groundwater. During project operations, the first 800 TAF of annual water supply are delivered under Class 1 contracts.

- Class 2 contracts are for a supplemental supply, and this supply is delivered directly for agricultural use or for groundwater recharge, generally in areas that experience groundwater overdraft.

In addition to Class 1 and Class 2 water deliveries, Reclamation Reform Act of 1982 water is provided in Section 215 of the act, which authorizes the delivery of unstorable irrigation water that would be released in accordance with flood management criteria or unmanaged flood flows. Delivery of Section 215 water has enabled groundwater replenishment at levels higher than otherwise could be supported with Class 1 and Class 2 contract deliveries.

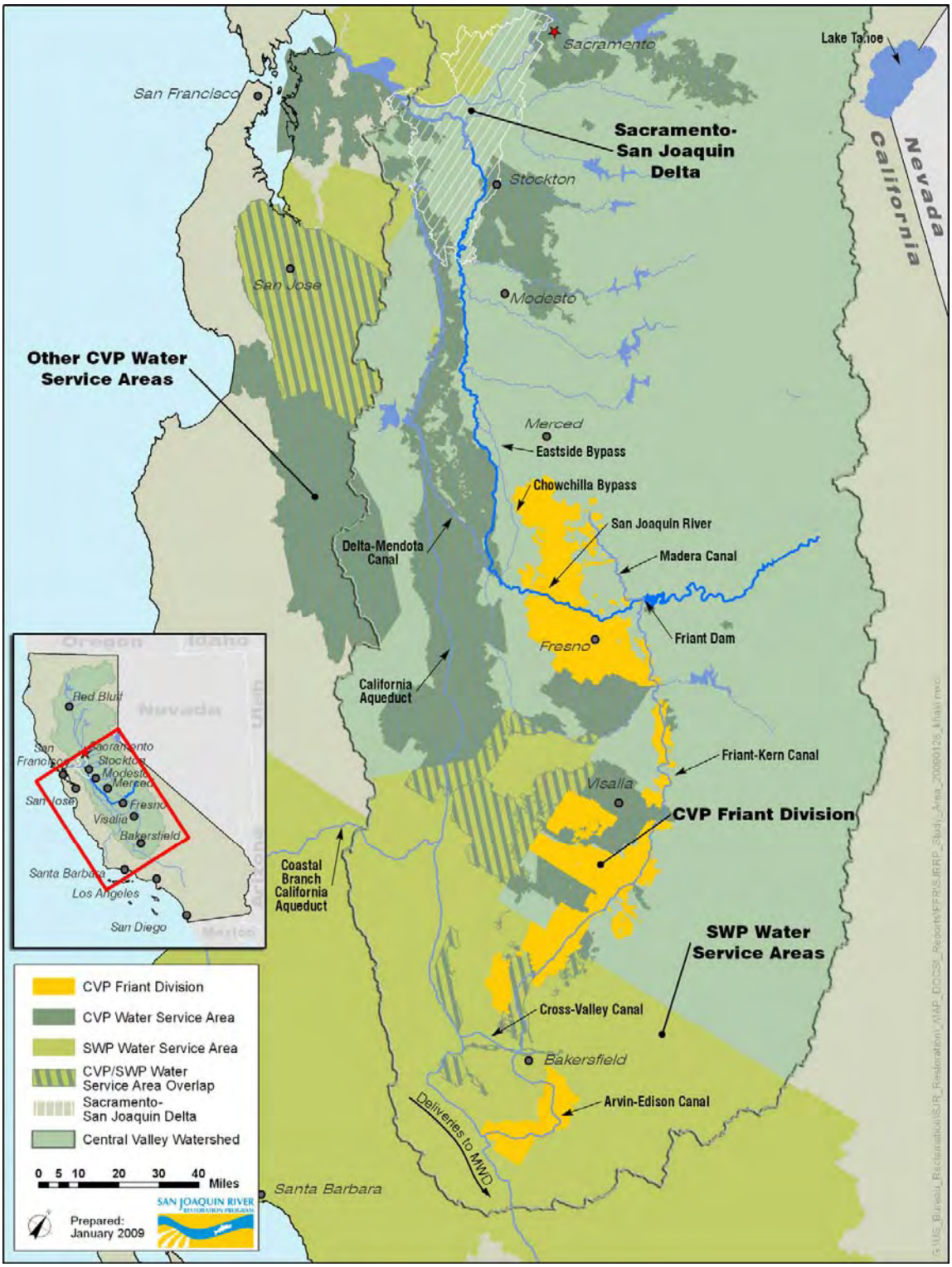

Figure 2-3.
South-of-Delta Service Areas of the CVP, SWP, and Local Agencies

Reclamation holds most of the water rights on the San Joaquin River, allowing diversion of water at Friant Dam through purchase and exchange agreements with entities holding those rights when the project was developed. With the exception of flood control operations, water released from Friant Dam to the San Joaquin River is limited to that necessary to satisfy riparian water rights and holding contracts along the San Joaquin River between Friant Dam and Gravelly Ford. The highest priority agreement involving the largest amount of water requires annual delivery of approximately 840 TAF of water to the Mendota Pool to water right holders along the San Joaquin River. This obligation is typically met with water exported from the Delta via the DMC in accordance with San Joaquin River Exchange Contracts. If Delta water were not available to meet these commitments, Reclamation would have to release water from Friant Dam to meet these commitments.

2.5.2 Other Central Valley Project Water Service Areas and Facilities

Owned and operated by Reclamation, the CVP is the State's largest water supply and delivery system. The CVP supplies water to more than 250 long-term water contractors in the Central Valley, Santa Clara Valley, and Bay Area. Project purposes include flood control; navigation; water supply; fish and wildlife protection, restoration, and enhancement; and power generation. CVP facilities include 20 dams and reservoirs with a combined storage capacity of more than 11 million acre-feet (MAF), 39 pumping plants, 2 pumping-generating plants, 11 powerplants, and more than 500 miles of major canals and aqueducts. The CVP has three primary storage facilities in Northern California: Shasta (and its afterbay, Keswick), Trinity, and Folsom reservoirs. These primary CVP reservoirs have a total storage capacity of approximately 8 MAF. Major CVP storage facilities located south of the Delta include New Melones Reservoir on the Stanislaus River; Millerton Reservoir on the San Joaquin River; and San Luis Reservoir/O'Neill Forebay, which is a pumped-storage reservoir on the west side of the San Joaquin Valley shared with the SWP. Storage facilities south of the Delta provide 4 MAF of storage capacity for the CVP.

The DMC conveys water from the Jones Pumping Plant in the south Delta to agricultural lands in the San Joaquin Valley. Water not delivered directly from the DMC is diverted at the O'Neill Pumping Plant and O'Neill Forebay for delivery via the San Luis Canal to CVP contractors in the San Joaquin Valley, or to storage in San Luis Reservoir for later use. Most of the rest of the water continues to the south Central Valley, with some water diverted to Santa Clara County.

2.5.3 State Water Project Service Areas and Facilities

The SWP is the largest State-built, multipurpose water project in the country. DWR operates and maintains the SWP, which conveys an annual average of 2.5 MAF of water through 17 pumping plants, 8 hydroelectric power plants, 32 storage facilities, and more than 660 miles of aqueducts and pipelines. The SWP stores and transfers water from the Feather River basin (Lake Oroville) and exports Delta flows to the San Joaquin Valley, Bay Area, coastal counties, and Southern California. A total of 29 contracting agencies receive water from the SWP.

In the south Delta, Banks Pumping Plant lifts water from the Clifton Court Forebay into Bethany Reservoir; from Bethany, water is delivered to the San Joaquin Valley and Southern California via the California Aqueduct or to south Bay Area users via the South Bay Aqueduct. The 444-mile-long California Aqueduct conveys water to agricultural lands of the San Joaquin Valley, and mainly urban regions of Southern California. Water is diverted from the aqueduct through the Gianelli Pumping-Generating Plant for storage in San Luis Reservoir until it is needed for later use. SWP water service areas south of the Delta are shown in Figure 2-3.

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3.0 Development of Alternatives

The purpose of including alternatives in the PEIS/R is to disclose the potential impacts of implementing the Settlement consistent with the Act, and to offer a clear basis for choices by decision-makers on whether and how to proceed with a proposed action. To support formulation of alternatives, the purpose, need, and objectives of the SJRRP were defined and planning and implementation constraints were identified. This Draft PEIS/R evaluates alternative approaches to implement the provisions of the Settlement consistent with the Act and other Federal, State, and local laws, and future agreements with downstream agencies, entities, and landowners.

3.1 Settlement Actions to Be Addressed in the PEIS/R

In accordance with the Rules and Regulations for Implementation of the National Environmental Policy Act of 1969 (73 CFR 61317, 2008), and Sections 15161 and 15168 of the State CEQA Guidelines, the PEIS/R is a "program" document that will address regional influences, secondary effects, and cumulative impacts that would result from implementing broad alternatives to accomplish the goals and objectives of the SJRRP. Specific actions to implement the SJRRP will be taken by the Implementing Agencies or others through subsequent site-specific projects.

Technical and environmental documents to support subsequent actions may incorporate the findings of the PEIS/R by reference. Through this approach, the PEIS/R is intended to simplify and streamline the task of preparing environmental documents for implementing subsequent SJRRP actions. The PEIS/R is also a "project" document, providing NEPA and CEQA compliance for the release of Interim and Restoration flows through reoperation of Friant Dam. Table 3-1 summarizes the level of environmental compliance supported by the PEIS/R for Settlement actions.

This Draft PEIS/R supports NEPA and CEQA compliance for reoperation of Friant Dam. This Draft PEIS/R also will support a long-term water right petition to allow the recapture of Interim and Restoration flows. Actions to achieve the Restoration and Water Management goals are be included in the program alternatives and analyzed at a program level of detail in this Draft PEIS/R. For these actions, an anticipated range of future construction and management actions are included in the alternatives to bracket the range of effects. This bracketed range of potential effects also allows an informed analysis of system-wide and cumulative impacts from implementing the SJRRP in its entirety.

Table 3-1.
Restoration and Water Management Actions in Key Settlement Paragraphs

Settlement Paragraph	Description	Level of NEPA/CEQA Compliance Supported by This Draft PEIS/R
11	Identifies specific channel and structural improvements considered necessary to achieve the Restoration Goal. Includes a list of improvements.	Program Level
12	Acknowledges that additional channel or structural improvements not identified in Paragraph 11 may be needed to achieve the Restoration Goal.	Program Level
13	Identifies specific volumes of water to be released from Friant Dam during different year types (Restoration Flows), and provisional water supplies to meet the Restoration Flow targets, as provided in Exhibit B of the Settlement. Stipulates the release of full Restoration Flows no later than January 1, 2014, subject to then-existing channel capacities.	Project Level
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 self-sustaining spring-run Chinook salmon over fall-run Chinook salmon.	Program Level
15	Specifies that a program of Interim Flows begins no later than October 1, 2009, and continues until full Restoration Flows can begin, to collect relevant data concerning flows, temperatures, fish needs, seepage losses, recirculation, recapture, and reuse.	Project Level for release of Interim Flows and related actions Program Level for some data collection activities
16	Requires that the Secretary 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.	Project Level for recapture in the Restoration Area and in the Delta Program Level for all other Water Management actions

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

3.2 Alternatives Formulation and Implementation Constraints

Implementing SJRRP actions will involve modifying river channels, flood management facilities, water supply operations, and water delivery systems. Such modifications must be considered in relation to existing uses, facility configurations, and legal conditions associated with existing conditions. For example, existing channel capacity was identified as a constraint during Settlement planning and was addressed in part through some specific actions described in Paragraph 11. Additional information regarding possible constraints and assumptions to be considered in formulating program alternatives was identified in prior and ongoing studies, or received as input from the Implementing Agencies, Settling Parties, stakeholders, and the interested public. Specific constraints and assumptions relevant to program alternatives formulation and implementation include the following:

- **Restricted Channel Capacity –** Portions of the San Joaquin River do not currently have channel capacity to convey full Restoration Flows, and some areas have historically been prone to seepage. The Settlement provides for modifications to increase channel capacity at specified locations. During future implementation of Settlement actions, Interim and Restoration flows will be constrained by then-existing channel capacities.

- **Flood Management –** Flood management is a primary and authorized purpose of Friant Dam. Downstream components of the flood management systems were designed and constructed by the State of California and local agencies. Modifying the flood management system to support restoration must not compromise flood management or the level of protection provided by these systems, in accordance with the Settlement.

- **Irrigation Flows –** Portions of the San Joaquin River in the Restoration Area are used to convey irrigation flows. Implementation of program alternatives must not adversely affect the ability to deliver water supplies to water users along the San Joaquin River.

- **Water Delivery Impacts –** The Settlement specifies the quantity of water allocated for Restoration Flows on an annual basis, and provides flow schedules. The specified flows are used to establish estimated impacts to Friant Division long-term contractors that would result from implementing Interim and Restoration flows. Implementing flow schedules must not increase water supply impacts.

- **Water Management Effects on the Restoration Goal –** In accordance with the Settlement, actions to achieve the Water Management Goal will not adversely affect achievement of the Restoration Goal.

- **Third Party Water Rights –** Implementing the Settlement must not modify or amend rights and obligations under existing contracts between the United States and the San Joaquin River Exchange Contractors Water Authority.

- **Laws, Regulations, and Policies –** In implementing the Settlement, the Implementing Agencies must comply with all laws, regulations, and policies.

3.3 Range of Final Program Alternatives

Formulation of a range of program alternatives for evaluation in this Draft PEIS/R began with a review of Settlement provisions for achieving the Restoration and Water Management goals. This was followed by identifying the purpose, need, and objectives; developing criteria for including actions in the program alternatives; defining planning and implementation constraints; and identifying related projects and opportunities associated with achieving the purpose and need. These steps were applied to actions, identified in Settlement provisions and in comments received during the public scoping process, to identify a range of alternatives to be addressed. The IPAR identified a reasonable range of alternatives and eliminated some potential actions, as previously described.

Several sources of information were used in formulating program alternatives for evaluation in this Draft PEIS/R. These included the Settlement, previous and ongoing studies that address possible Restoration and Water Management strategies or actions, input from Settling Parties and other stakeholders, and input received from the public through the NEPA and CEQA scoping processes. Following the release of the NOP and NOI, Reclamation and DWR held a series of formal public scoping meetings throughout the study area during the specified scoping period. Reclamation and DWR also held a series of informal meetings during development of alternatives to receive input from a range of interested parties.

The Implementing Agencies received numerous suggestions for potential actions to achieve the goals of the Settlement. Each suggestion was reviewed for inclusion in program alternatives relative to the planning considerations, including NEPA and CEQA requirements, the project purpose and objectives, and the need for action, as well as associated opportunities and planning constraints. Some actions suggested during the scoping process and considered by the SJRRP were not retained for inclusion in the program alternatives because they would not meet the purpose, need, and objectives of the Settlement, including the following:

- **Release Restoration Flows of a different timing and magnitude than those presented in Exhibit B of the Settlement –** The Settlement specifies the timing and magnitude of Restoration Flows, and provides flexibility in the flow schedules through provisions that include flexible flow periods and buffer flows. Consistent with Exhibit B of the Settlement, alternative methods for allocating flow and alternative methods for transforming allocated flows between flow schedules for the six year types were considered. However, implementing

alternatives to the flow schedules, beyond the alternative allocation and transformation methods, would be inconsistent with the Settlement. This action was not retained because it would prevent achieving the SJRRP purpose.

- **Utilize the Chowchilla Bypass to Route Interim Flows and/or Restoration Flows on a Permanent Basis –** Routing of Interim and/or Restoration flows through the Chowchilla Bypass instead of through the San Joaquin River on a permanent basis would not be consistent with the Restoration Goal, which is to "restore and maintain fish populations in good condition in the main stem of the San Joaquin River." This action was not retained because it would prevent achieving the SJRRP purpose and need, consistent with the Settlement.

- **Restore other rivers in California that are currently undergoing restoration –** Restoration of other river systems in the State would not meet the SJRRP purpose. The Restoration Goal calls for restoring the San Joaquin River, not other rivers. This action was not retained because it does not substantially contribute to the SJRRP purpose.

- **Consider population growth, and demands on water supply in the San Joaquin Valley and throughout California –** The Settlement specifies the amount of water to be used for restoration, and impacts on water users are considered in the program alternatives analyses presented in this Draft PEIS/R. Implementing a policy to limit population growth in California does not contribute to the SJRRP purpose. This action was not retained because it does not substantially contribute to the SJRRP purpose.

- **Encourage the Central Valley Regional Water Quality Control Board to develop salinity standards/restrictions to cap salt loading to the San Joaquin River –** While this could benefit the SJRRP goals, it would require a broad program with many entities and many years to complete, does not directly contribute to the Restoration or Water Management goals, and is not necessary for achieving the SJRRP purpose. This action was not retained because it does not substantially contribute to the SJRRP purpose.

- **Remove trash and debris from the river –** The SJRRP would consider removing debris that may adversely affect Restoration actions. However, while removing trash/debris from the river may help restoration efforts, it would exceed the needs of the Implementing Agencies for implementing the Settlement. This action was not retained because it does not substantially contribute to the SJRRP purpose.

- **Design and create a conservation zone from the river parkway to the San Francisco Bay Area –** The SJRRP could fit into a conservation zone if one were formed, but this would require efforts beyond those required for restoration of the 150-mile reach of the San Joaquin River. This action was not retained because it does not substantially contribute to the SJRRP purpose.

- **Raise Friant Dam to store more water for dry year supply and provide flood control –** Because of the long lead time for permitting, design, and construction of this type of project, it would not satisfy the implementation timing necessary if used for Restoration Flows. Also, development of additional storage at or upstream from Friant Dam is currently being studied under separate authorization. This action was not retained because it does not substantially contribute to the SJRRP purpose.

- **Require the Central Valley Flood Protection Board to ensure the integrity of the flood management system through a permitting process before any activity affecting the system is undertaken –** Potential impacts of implementing program alternatives on the flood control system, and appropriate mitigation measures, are presented in this Draft PEIS/R. The Central Valley Flood Protection Board (CVFPB) is responsible for reviewing and approving proposed projects that could affect the integrity of flood management systems. Incorporating this activity into the program alternatives would be redundant to existing processes. This action was not retained because it does not substantially contribute to the SJRRP purpose.

ne track focused on actions to address reoperation of Friant Dam, and was developed in coordination with the Settling Parties through preparation of Restoration Flow guidelines, as stipulated by the Settlement. The other focused on defining the range of potential implementation of physical actions to achieve the Restoration and Water Management goals. To accomplish the second track, a broad range of actions to achieve the Restoration and Water Management goals was packaged into initial program alternatives, as described in the *Initial Program Alternatives Report* (IPAR) (SJRRP 2008).

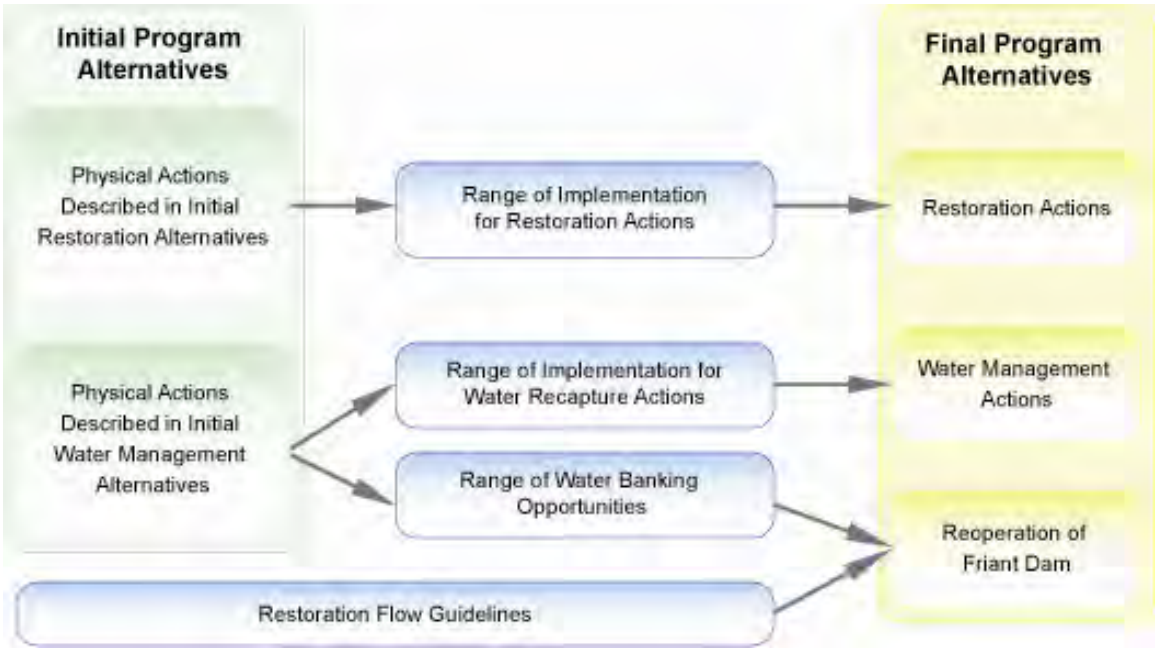

Figure 3-1.
Approach for Formulation of Final Program Alternatives

The IPAR evaluated numerous actions, and ultimately described eight initial alternatives for the Restoration Goal and eight initial alternatives for the Water Management Goal, all with a primary emphasis on ranges of physical actions. This approach was chosen to identify the possible range of physical actions that could be implemented through subsequent site-specific projects. Initial Restoration Alternatives were formulated by grouping potential Restoration actions based on various themes for river restoration. Initial Water Management Alternatives were formulated by grouping potential projects to recapture Interim and Restoration flows with facilities to convey or store water in the Friant Division water service areas. The potential range for each Restoration and Water Management action was represented within the range of Initial Restoration and Water Management alternatives presented in the IPAR. The initial physical actions presented in the IPAR provided a starting point for formulating a range of program alternatives that would achieve the purpose, need, and objectives of the proposed action. Actions to address reoperating Friant Dam for the release of Interim and Restoration flows and actions to address reintroducing Chinook salmon were not described in the IPAR (SJRRP 2008).

A review of initial program alternatives presented in the IPAR revealed that the level of project specificity in the alternatives was greater than the level of certainty that can be determined at this time with limited available information. Because land access has not been granted to the Implementing Agencies for many key locations in the Restoration Area, despite continued efforts to obtain access, the Implementing Agencies could not initiate studies needed to collect more detailed information about site conditions for developing project-specific plans concurrent with preparation of this Draft PEIS/R. The Implementing Agencies recognize the need for a robust monitoring program to collect information on physical and ecological responses to actions to guide site-specific project requirements.

In recognition of the data limitations, and reliance on future monitoring data, final program alternatives are defined more broadly and include provisions for flexibility in implementation. Accordingly, program alternatives evaluated in this Draft PEIS/R address large-scale system-wide variations, with flexibility for different methods of implementation. The different methods of implementation represent key decision points, including the ultimate extent of channel modifications and flow routing within the Restoration Area, and the extent and location of long-term water recapture opportunities. This approach is appropriate for identifying ranges of potential impacts that could result from implementing the Settlement, and for developing appropriate mitigation strategies at a program level of detail.

The program alternatives evaluated in this Draft PEIS/R represent a range of reasonable alternatives, consistent with the requirements of NEPA and CEQA. The action alternatives under consideration were formulated to feasibly accomplish the primary objectives of the Settlement, as discussed in Chapter 1.0, “Introduction” of this Draft PEIS/R. The action alternatives include features that could avoid or substantially lessen one or more significant effects. Additional information on the No-Action and action alternatives is presented in Section 2.0, “Description of Alternatives.”

3.3.1 Actions for Reoperating Friant Dam and Downstream Flow Control Structures

Paragraphs 13 and 15 and Exhibit B of the Settlement describe several provisions for reoperating Friant Dam, including the requirement to develop a more continuous-line hydrograph for release of Restoration Flows, provisions for flexible management of Restoration Flows, management of buffer flows, acquisition and release of additional water for unanticipated seepage losses, and the release of short-term pulse flows.

Annual water allocations and flow schedules for releasing the Interim and Restoration flows described in the Settlement are based on six Restoration Year Types that were defined for purposes of the Settlement. The Restoration Year Types were developed for the Settlement using historical hydrologic information from 1922 through 2005, as shown in Table 3-2. The six flow schedules specify average monthly Restoration Flows to be released from Friant Dam, as shown in Figure 3-2, plus five key downstream locations within the Restoration Area.

Table 3-2.
Restoration Year Types as Defined in Exhibit B of the Settlement

Restoration Year Type[1]	Range of Unimpaired Inflow to Millerton Lake (acre-feet per year)	Percentage of Years from 1922 Through 2005
Wet	Greater than 2,500,000	20 Percent
Normal-Wet	Greater than 1,450,000 to 2,500,000	30 Percent
Normal-Dry	Greater than 930,000 to 1,450,000	30 percent
Dry	Greater than 670,000 to 930,000	15 percent
Critical-High	Greater than 400,000 to 670,000	5 percent
Critical-Low	Less than 400,000	

Note:
[1] Restoration years begin October 1 and end September 30 of the following calendar year.

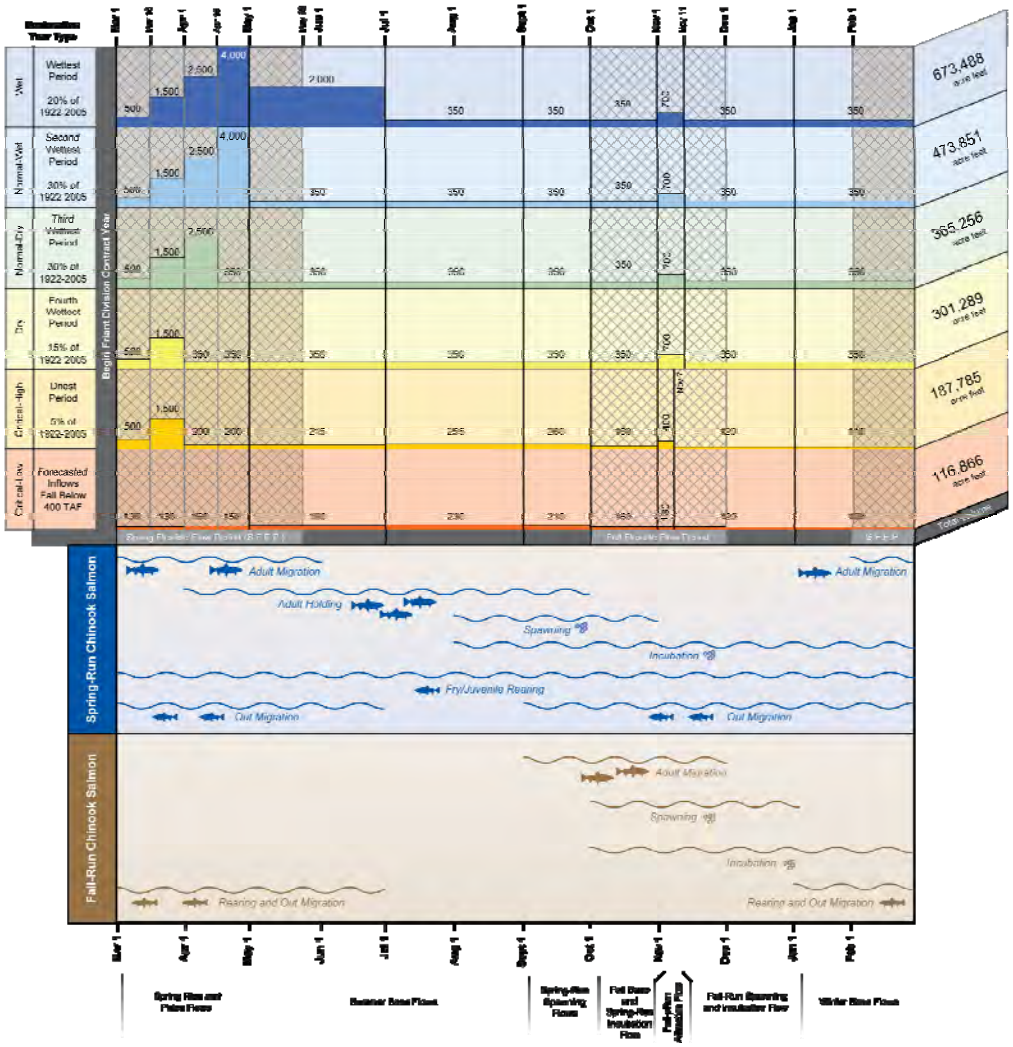

Figure 3-2.
Release Flow Schedules Specified in Exhibit B of the Settlement

This Draft PEIS/R described the reoperation of Friant Dam at a project level of detail. In formulating alternatives for the PEIS/R, several actions that affect the release of Interim and Restoration flows were considered, including the following:

- Smooth the transitions for release of Restoration Flows from the flow schedules presented in Exhibit B of the Settlement. This process involves two distinct steps: (1) develop a method to allocate annual Restoration Flows, and (2) distribute the annual allocation between the time periods identified in the Settlement (Exhibit B) flow schedules.

- Evaluate the potential effects of real-time flow adjustments provided in the Settlement, including flexible flow periods, release of buffer flows, release of acquired water for seepage losses, ramping guidelines, and flushing flows.

- Develop guidelines for the release of flows (see Friant Dam Releases for Restoration Flows Attachment) addressing the Settlement provisions.

The formulation of Interim and Restoration flow releases for consideration in PEIS/R alternatives is described in the following sections.

Restoration Flow Annual Allocation Methods

The Settlement directs the Settling Parties to develop a more continuous-line hydrograph from the six flow schedules presented in Exhibit B of the Settlement for releasing Restoration Flows. The first step in this approach involves developing more gradual changes in annual allocations of total water supply dedicated to Restoration Flows. As shown in Figure 3-3, the annual volume allocated to the six Restoration Year Types in Exhibit B of the Settlement can produce abrupt changes in annual allocated Restoration supply as a result of small changes in inflow to Millerton Lake. As also illustrated in Figure 3-3, a continuous-line annual allocation should reduce the potential that small changes in forecasted inflow to Millerton Lake would cause abrupt changes in total annual allocation of Restoration Flows.

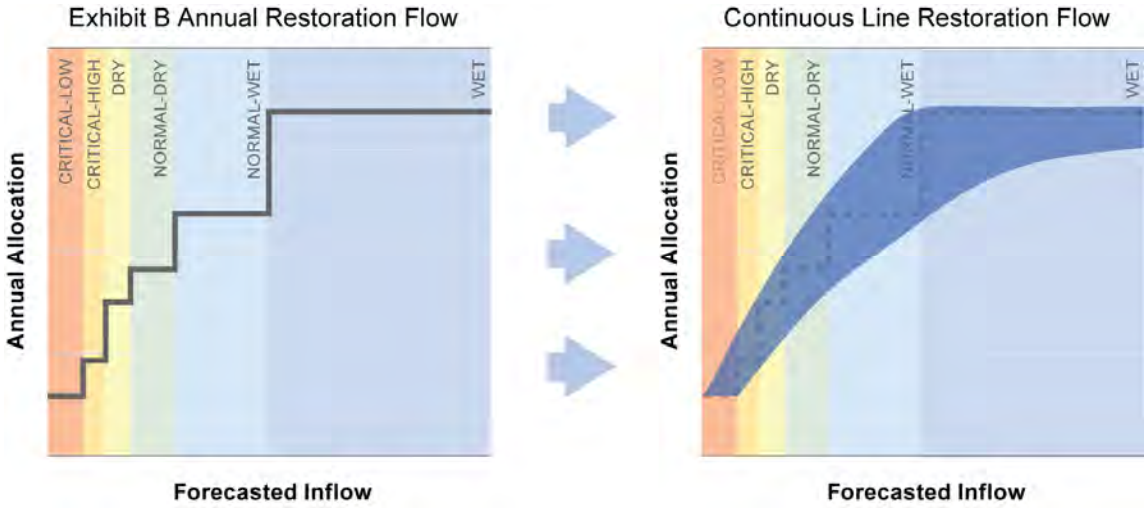

Figure 3-3.
Conceptual Approach for Developing a Continuous Line Annual Allocation

Eight alternative methods were considered for developing an annual allocation of Restoration Flow volume based on total water supply available at Friant Dam. Each method was evaluated to determine if it affected either the Restoration Goal or the Water Management Goal, compared with the application of the stair-step hydrograph in Exhibit B of the Settlement. The seven annual allocation methods were developed, evaluated, and compared for inclusion in program alternatives, as described in the Restoration and Friant Dam Releases for Restoration Flows Attachment, and summarized below:

- Method 1 is the stair-step annual allocation method presented in Exhibit B of the Settlement. This method directly applies Settlement language for determining a single annual volume allocation for each of the six Restoration Year Types. Because this method would represent a default operation in the absence of a continuous line hydrograph, it was retained for inclusion in program alternatives.

- Method 2 is a continuous line allocation that interpolates annual allocation across the range of forecasted inflows between Critical-Low and Wet Restoration Year

Types. This method retains a stair-step allocation for Critical-Low years, interpolates Critical-High through Normal-Wet years, and maintains a stair-step in Wet years. This method would not maintain continuous flows to the Merced River during Critical-High years or provide sufficient volumes in all Normal-Wet years to support gravel mobilization. Method 2 reduces the intended ecosystem functions for both Critical-High and Normal-Wet years and, therefore, was not retained for inclusion in program alternatives.

- Method 3 was developed to address ecological limitations identified in Method 2. Method 3.1 was retained for inclusion in program alternatives because it appears to have the smallest deviation in water deliveries compared to Method 1. Four variations were progressively developed (Methods 3.0 through 3.3) to address concerns of the Settling Parties. Method 3.0 is similar to Method 2, except that it includes adjustments for the ecological deficiencies in Critical-High year types, in the form of flushing flows to mobilize gravel. Method 3.1 is similar to Method 3.0, except that it includes adjustments for ecological deficiencies identified in the Method 2 during Normal-Wet year types and adjusts the annual allocations for Dry year types to provide a lower bound for water supply impacts for the Dry year type interpolation. Method 3.2 is similar to Method 3.1, with the exception of the Dry year type allocations, which were adjusted to define an upper bound of water supply impacts for the Dry year type interpolation. Method 3.3 is similar to Method 3.2, except that it was designed to reduce water supply impacts resulting from Method 3.2. None of the approaches considered under Method 3 would adversely affect achievement of the Restoration Goal.

- Method 4 is similar to Method 3.0, except that it averages restoration allocations across both year types, instead of attempting to maintain allocations constant within each Restoration Year Type. Method 4 would result in greater water supply impacts in Critical-High year types and reduced impacts during Dry year types compared to Method 1. This method was not retained for inclusion in program alternatives because it would introduce further complexity in resolving water supply impacts between different Restoration Year Types.

Annual allocation volumes for Restoration Flows developed with the continuous line hydrograph method would rarely match the volumes corresponding to the six Restoration Year Type flow schedules in Exhibit B of the Settlement. Therefore, a method was developed to transform the monthly distribution of annual allocations between Restoration Year Types. Methods to transform monthly flow schedules were developed based on seven ecological intentions of the flow schedules to support spring-run and fall-run Chinook salmon.

Other Actions for the Management of Restoration Flows

In addition to allocating and scheduling the release of Interim and Restoration flows, the Settlement provides for adjusting the release from Exhibit B of the Settlement to meet real-time objectives. Real-time adjustments include the following:

- **Flexible flow periods –** Flexible flow periods identified by the Settlement during spring and fall periods that would allow those flows to be shifted up to 4 weeks earlier and later than shown in the Exhibit B of the Settlement flow schedules

- **Buffer flows –** Release of buffer flows in accordance with Settlement provisions in Paragraphs 13(a), which would provide for increasing flows by up to 10 percent over Exhibit B schedules

- **Acquired water –** Release of up to 60 TAF per year of water acquired from willing sellers in accordance with Settlement provisions in Paragraph 13(c) if unexpected seepage losses exceed those estimated in the Settlement

3.3.2 Restoration Actions

Paragraphs 11 and 12 of the Settlement describe river channel and facility modifications to achieve the Restoration Goal. Paragraph 14 provides direction regarding the reintroduction of Chinook salmon to the river. Paragraph 11 identifies specific projects that would be implemented to support the Restoration Goal, and Paragraph 12 states that additional potential actions not identified in the Settlement may be necessary to support the Restoration Goal. It is expected that Paragraph 11 and Paragraph 12 actions would be implemented in consideration of the suite of life history strategies used by rearing spring-run Chinook salmon, which may vary spatially and temporally. For example, in a given year, and depending on environmental conditions, some salmon from a single cohort (age group) could emigrate downstream shortly after emergence, and rear in downstream areas with suitable habitat conditions before entering the Delta and the ocean in their first year of life (an ocean-type life history strategy). Others from the same cohort, however, could remain in upstream areas to rear for 1 or more years, and then emigrate downstream as yearlings or older fish (a stream-type life history strategy).The range of actions included in the alternatives under Paragraphs 11 and 12 provides flexibility during implementation to reflect the uncertainty in life history patterns of future salmon populations. Restoration actions retained for inclusion in program alternatives include the following:

- **Paragraphs 11(a)(1) and 11(a)(2)** – Construct Mendota Pool Bypass and Modify Reach 2B to convey at least 4,500 cfs

- **Paragraph 11(a)(3)** – Modify Reach Reach 4B1 to convey at least 475 cfs

- **Paragraph 11(a)(4)** – Modify San Joaquin River Headgate Structure to enable fish passage

- **Paragraph 11(a)(5)** – Modify Sand Slough Control Structure to enable fish passage and flow routing

- **Paragraphs 11(a)(6) and 11(a)(7)** – Screen Arroyo Canal and provide fish passage at Sack Dam

- **Paragraphs 11(a)(8) and 11(a)(9)** – Modify Eastside and Mariposa bypasses to enable fish passage

- **Paragraph 11(a)(10)** – Enable deployment of seasonal barriers at Mud and Salt sloughs
- **Paragraph 11(b)(1)** – Modify Reach 4B1 to convey at least 4,500 cfs
- **Paragraph 11(b)(2)** – Modify Chowchilla Bypass Bifurcation Structure
- **Paragraph 11(b)(3)** – Fill or isolate gravel pits
- **Paragraph 11(b)(4)** – Modify Sand Slough Control Structure to enable effective routing and conveyance of Restoration Flows of up to 4,500 cfs into Reach 4B1
- **Paragraph 12** – The following are potential actions pursuant to Paragraph 12:
  - Enhance Spawning Gravel
  - Reduce Potential for Redd Superimposition and/or Hybridization
  - Supplement Salmon Population
  - Modify Floodplain and Side-Channel Habitat
  - Enhance In-Channel Habitat
  - Reduce Potential for Aquatic Predation of Juvenile Salmonids
  - Reduce Potential for Fish Entrainment
  - Enable Fish Passage
  - Modify Flood Flow Control Structures

Potential River Channel and Facility Modifications

As mentioned, eight initial restoration alternatives were presented in the IPAR to address a wide range of possible project implementation at a level of specificity to allow assessments of potential effects at a program level. A thematic approach guided the inclusion of restoration actions in each initial restoration alternative. Most initial restoration alternatives considered restoration actions only in river and bypass channels identified in Paragraph 11; however, some also included the use of the Chowchilla Bypass for conveying Restoration Flows. When initial restoration alternatives were combined with actions to manage Interim and Restoration flows, it was recognized that use of the Chowchilla Bypass as a permanent alternative flow route would prevent achievement of Settlement-stipulated flow targets at the heads of Reaches 3 and 4. Because a permanent alternative flow route is not consistent with the Settlement, it was dropped from further consideration.

Initial restoration alternatives presented in the IPAR define specific implementation of various actions, such as the extent of floodplain habitat restoration, among others.

However, because of limited information available at this time, the Implementing Agencies concluded that selection and implementation of program alternatives with the high level of specificity described in initial program alternatives would limit the flexibility necessary for successful implementation. Therefore, the range of restoration actions in program alternatives was broadened to include all initial restoration alternatives, with the exception of those that considered use of the Chowchilla Bypass for restoration. In this manner, the restoration actions retained for inclusion in program alternatives are defined at the level of specificity provided in Settlement Paragraph 11. In particular, two issues were identified that represent the greatest range of potential uncertainty in implementing restoration actions:

- The extent and type of floodplain habitat in Reaches 2B and 4B necessary to support rearing and migration cannot be sufficiently defined at this time. Therefore, all program alternatives retain the full range of anticipated floodplain modifications to allow flexibility during implementation. This range will define a starting set of alternatives for site-specific evaluations.

- The extent of isolation of gravel pits in Reach 1 necessary to support fisheries restoration cannot be determined at this time. Therefore, all of the program alternatives retain the full range of modifications in Reach 1 to allow flexibility during implementation. This range will define a starting set of alternatives for site-specific evaluations.

Development of initial restoration alternatives also helped identify additional potential actions not included in the Settlement that could contribute to achieving the Restoration Goal, pursuant to Paragraph 12. Decisions to implement potential Paragraph 12 actions will rely on information collected through monitoring. These actions are retained in all program alternatives. Because additional information that will be collected during SJRRP implementation is needed to better define actions to implement Paragraph 11 and potential Paragraph 12 actions, a single set of potential actions to achieve the Restoration Goal was developed for inclusion in all program alternatives.

Salmon Reintroduction

Paragraph 14 of the Settlement addresses reintroducing spring-run and fall-run Chinook salmon between Friant Dam and the confluence of the San Joaquin River with the Merced River by December 31, 2012. Paragraph 14 states that, “in the event that competition, inadequate spatial or temporal segregation, or other factors beyond the control of the Settling Parties make restoring spring-run and fall-run Chinook salmon infeasible, then priority shall be given to restoring self-sustaining populations of wild spring run Chinook salmon.” The Secretary, through USFWS, and in consultation with the Secretary of Commerce, DFG, and the RA, will reintroduce spring- and fall-run Chinook salmon “at the earliest practical date after commencement of sufficient flows and the issuance of necessary permits.” To help facilitate reintroduction of salmon, a management plan has been developed to help guide implementation of Restoration actions. The range of potential actions for salmon reintroduction spans from reintroducing only spring-run Chinook salmon to reintroducing both fall-run and spring-run Chinook salmon, and could include one or more life stages. Broodstocks would be

identified through subsequent studies, and because of the uncertainty associated with broodstock life history, behavioral, and adaptive traits of potential broodstock in the Central Valley, it is most likely that broodstocks would be acquired from a variety of watersheds.

The range of potential actions for salmon reintroduction could also include the use of the existing San Joaquin Hatchery, another existing hatchery, or a new hatchery. Although the design and capacity of a new hatchery would be determined in part by management plans, a new hatchery could potentially provide for initial reintroduction of spring-run Chinook salmon, fall-run Chinook salmon, and/or other native fish. Hatchery use would be phased out over time as the fish population is reestablished. The Restoration Goal and Paragraph 14 of the Settlement emphasize the need to restore self-sustaining fish populations. Therefore, hatchery populations alone would not fulfill the Restoration Goal, and naturally reproduced individuals would need to be distinguished from hatchery-produced individuals.

This Draft PEIS/R identifies potential system effects associated with reintroducing salmon. USFWS submitted a 10(a)(1)(a) Enhancement of Species Permit application to NMFS on September 30, 2010, for introducing an experimental population of spring-run Chinook salmon, consistent with the schedule identified in the Settlement. NMFS will issue a final rule pursuant to Section 10(j) of the Federal Endangered Species Act of 1973 (ESA), as amended, by April 30, 2012. Specific environmental effects related to the reintroduction of spring-run Chinook salmon would be addressed in the subsequent project-specific NEPA analysis, and possibly CEQA analysis, in compliance with an associated Special Rule authorizing the experimental population.

3.3.3 Water Management Actions

Water management actions are based on two mechanisms identified in the Settlement to reduce or avoid the impact of Interim and Restoration flows to Friant Division long-term contractors:

- Paragraph 16(a) actions include the recapture of Interim and Restoration flows, and the recirculation, reuse, exchange and/or transfer of recaptured supplies to Friant Division long-term contractors.

- Paragraph 16(b) provides for the delivery of water during wet hydrologic conditions to Friant Division long-term contractors at a cost of $10 per acre-foot, as limited by an RWA.

Actions that could be implemented to achieve the Water Management Goal are analyzed in the PEIS/R at a program level of detail. Subsequent project-specific environmental compliance will be required for actions that could not be implemented under existing regulatory requirements and institutional arrangements. Potential water management actions are described in the following sections for three locations: at Friant Dam, along the San Joaquin River, and in the Delta.

Water Management Actions at Friant Dam

Implementation of Paragraph 16(b) actions could affect the amount of water that is released to the San Joaquin River in excess of Restoration Flow requirements during wet periods. This effect of diverting water from Friant Dam pursuant to Paragraph 16(b) is based on the following assumptions:

- Water at Friant Dam would be eligible for delivery to Friant Division long-term contractors pursuant to Paragraph 16(b) when inflow to Millerton Lake exceeds storage capacity, Restoration Flow requirements, and delivery requirements to meet existing contract deliveries.

- Paragraph 16(b) water would be conveyed through the Friant-Kern and Madera canals only when capacity is available without impacting requirements to meet existing contract deliveries to the Friant Division long-term contractors.

- The potential future demand for Paragraph 16(b) water is based on the assumed implementation of projects that increase surface water conveyance or groundwater recharge capacity (see Paragraph 16(b) Actions Considered in Program Alternatives Attachment).

It is anticipated that Friant Division long-term contractors would be able to accept delivery of some Paragraph 16(b) water using existing water conveyance and storage facilities. Because 16(b) water would likely be available predominantly during nonirrigation periods, it is expected that Friant Division and non-Friant Division water users could develop additional local conveyance and storage capacity to increase their ability to receive 16(b) water supplies.

Water management actions include the change in ability of Friant Division contractors to receive water supplies due to implementation of a reasonable range of projects to convey and store 16(b) water deliveries on the operations of Friant Dam, releases to the San Joaquin River, and diversions to the Friant-Kern and Madera canals. The groundwater banking recharge capacity associated with these potential projects was estimated. Potential projects for direct and in-lieu recharge are not included in this alternative because these could be implemented by local water users through separate project-specific planning, design, and environmental compliance processes.

The ability to modify or construct and use new local conveyance and storage facilities will rely on the knowledge and funding mechanisms of the Friant Division long-term contractors, and would have purpose(s) beyond the purpose of implementing the Settlement. Therefore, most of these potential actions are not retained for implementation

in the program alternatives. However, the range of ability to receive water supplies, from the existing capacity to a reasonable future capacity, will be included in the evaluations of the program alternatives, as described in the Paragraph 16(b) Actions Considered in Program Alternatives Attachment.

As mentioned, Settlement Paragraph 16(b)(1) requires that an RWA be established to record reductions in water delivery to each Friant Division long-term water contractor resulting from the release of Interim and Restoration flows. For each long-term contractor, the RWA would adjust recorded reductions in deliveries by water delivered under Paragraph 16(a) and 16(b) actions, or other actions implemented using Federal or State funds, to reduce water supply delivery impacts resulting from the release of Interim and Restoration flows. This action is retained for inclusion in program alternatives.

Settlement Paragraph 16(b)(2 and 3) provide that water be made available during wet hydrologic conditions that exceeds Restoration Flow requirements to Friant Division long-term contractors, for $10 per acre-foot, consistent with the RWA. This action is retained for inclusion in program alternatives. Implementing this action could affect the amount of water that is released to the San Joaquin River in excess of Restoration Flow requirements during wet years. Effects on Friant Dam operations resulting from Paragraph 16(b) deliveries will depend on actions that would be taken by Friant water users to increase delivery capacity. In applying this action to program alternatives, a range of possible changes in delivery capacity will be estimated using information on potential projects identified by Friant water users, as described above.

Water Recapture Within Restoration Area

Water management actions include recapture of up to the total quantity of Interim and Restoration flows within the Restoration Area using existing facilities along the San Joaquin River. Paragraph 16(a)(1) of the Settlement provides that recapture and recirculation of Interim and Restoration Flows "shall have no adverse impact on the Restoration Goal, downstream water quality or fisheries," Because recapture within the Restoration Area could prevent the flow targets from being met, recapture within the Restoration Area would occur only if necessary to avoid interfering with in-channel construction activities associated with the Restoration Goal, or to avoid potential material adverse impacts from groundwater seepage or for other emergency actions to avoid immediate adverse impacts. Interim and Restoration flows would be recaptured consistent with Federal, State, and local laws, and future agreements with downstream agencies, entities, and landowners. Potential locations within the Restoration Area for recapture of Interim Flows include the Mendota Pool at the downstream end of Reach 2B, the Arroyo Canal at the downstream end of Reach 3, and the East Bear Creek Unit of the San Luis NWR (East Bear Creek Unit) in Eastside Bypass Reach 3. These recaptured flows along the San Joaquin River may provide deliveries in lieu of Delta-Mendota Canal (DMC) supplies. Up to a like amount of exported water would be available for recirculation to the Friant Division using south-of-Delta facilities. No additional agreements would be required to recapture flows in the Restoration Area. Recirculation of recaptured water to the Friant Division could require mutual agreements between Reclamation, DWR, Friant Division long-term contractors, and other south-of-Delta CVP/SWP contractors. Reclamation would assist Friant Division long-term contractors with the arrangement of agreements for the transfer

or exchange of flows recaptured at these locations. All action alternatives include potential recapture of Interim Flows within the Restoration Area.

Water Recapture in the Sacramento-San Joaquin Delta

Water management actions include recapture of Interim and Restoration flows in the Delta at existing CVP and SWP export facilities (Figure 3-4). Operations of these facilities would be subject to existing operating criteria, consistent with prevailing and relevant laws, regulations, biological opinions (BOs), and court orders in place at the time the water is recaptured. Any increase in Delta exports would be eligible for recirculation to the Friant Division. Recaptured water available to Friant Division long-term contractors would range from zero to the total amount of recaptured Interim and Restoration flows. Water recirculated to the Friant Division in this manner could require subsequent exchange agreements between Reclamation, DWR, Friant Division long-term contractors, and other south-of-Delta CVP/SWP contractors. Recirculation would be subject to available capacity within CVP/SWP storage and conveyance facilities including the Jones and Banks pumping plants, the California Aqueduct, the DMC, San Luis Reservoir and related pumping facilities, and other facilities of CVP/SWP contractors. A future review will be done to identify if any additional NEPA or CEQA compliance would be required to support these actions. All action alternatives include recapture of Interim and Restoration flows at existing CVP and SWP export facilities.

Water Recapture Along the San Joaquin River Downstream from Restoration Area

Water management actions include recapture of Interim and Restoration flows from the San Joaquin River below the Merced River confluence at existing pumping facilities owned and operated by CVP contractors who possess San Joaquin River water rights. This action is included in Alternatives B1, B2, C1, and C2.

Water Recapture at New Pumping Plant on the San Joaquin River

Water management actions include recapture at new pumping facilities along the San Joaquin River below the Merced River confluence for direct recapture of Interim and Restoration flows. The recaptured flows would be conveyed to the DMC or California Aqueduct. This action is included in Alternatives C1 and C2.

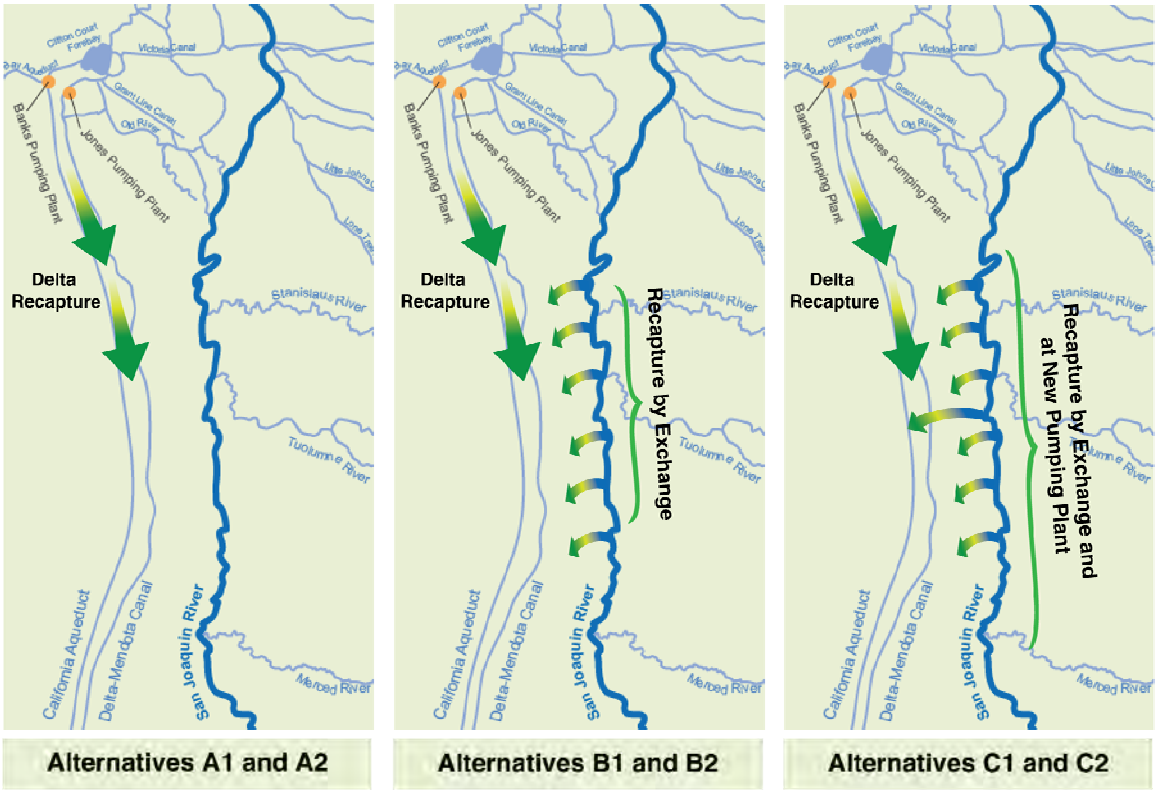

Figure 3-4.
Water Recapture Approaches Included in Program Alternatives

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4.0 Description of Alternatives

This section describes the No-Action Alternative and six action alternatives to implement the Settlement. The PEIS/R is intended to satisfy NEPA/CEQA requirements at a project-level for reoperating Friant Dam (including release of Interim and Restoration Flows) and downstream flow control structures and for recapturing flows at existing facilities in the Restoration Area and in the Delta, and at a program-level for other actions consistent with the Settlement. Actions for which program-level compliance is provided by the PEIS/R will require further evaluations and preparation of additional project-specific environmental compliance in the future. Both the project-level Interim and Restoration Flows and program-level actions reflect anticipated implementation ranges to identify potential environmental effects. All action alternatives include reoperation of Friant Dam, actions that contribute to the Restoration Goal, and actions that contribute to the Water Management Goal. The action alternatives differ primarily in how Restoration Flows are recaptured:

- **Alternatives A1 and A2 –** Recapture of Interim and Restoration flows in the Delta using existing facilities, operated under existing operating criteria.

- **Alternatives B1 and B2** – Recapture of Interim and Restoration flows in the Delta using existing facilities, operated under existing operating criteria, and additional recapture of Interim and Restoration flows in the San Joaquin River below the confluence of the Merced River using existing facilities.

- **Alternatives C1 and C2 –** Recapture of Interim and Restoration flows in the Delta using existing facilities, operated under existing operating criteria; additional recapture of Interim and Restoration flows in the San Joaquin River below the confluence of the Merced River using existing facilities; and additional recapture of Interim and Restoration flows through a new pumping station on the San Joaquin River below the confluence of the Merced River.

The action alternatives also vary by restoration actions in Reach 4B:

- **Alternatives A1, B1, and C1 –** Modifications in Reach 4B1 to carry up to 475 cfs

- **Alternatives A2, B2, and C2 –** Modifications Reach 4B1 to carry up to 4,500 cfs

4.1 No-Action and No-Project Alternatives

This Draft PEIS/R evaluates a No-Action Alternative in compliance with NEPA no-action and CEQA no-project requirements. The No-Action Alternative reflects projected conditions in 2030 if the Settlement is not implemented. The No-Action Alternative includes existing facilities, conditions, land uses, and reasonably foreseeable actions expected to occur in the study area by 2030. Reasonably foreseeable actions include actions with current authorization, complete funding for design and construction, and complete environmental permitting and compliance (see Table 4-1) when the NOP for the PEIS/R was published (August 22, 2007 (Reclamation)). Under the No-Action Alternative, Reclamation would continue to release a base flow from Friant Dam to meet existing holding contract obligations to maintain a 5 cfs flow at Gravelly Ford. The No-Action Alternative and existing conditions serve as the basis of comparison for determining potential effects of the action alternatives on the affected environment, consistent with NEPA and CEQA requirements (for the purposes of this document, existing conditions are defined as the conditions in place when the NOP was published in August 2007).

The No-Action Alternative would not include implementing the Settlement. Although the specific actions regarding *NRDC, et al., v. Kirk Rodgers, et al.* that would be taken under the No-Action Alternative are too speculative for meaningful consideration, and cannot be defined at this time, it is reasonable to assume that the Settlement would be voided and litigation would resume.

Additional simulation is being prepared to assess projected conditions under the No-Action Alternative with implementation of the USFWS 2008 *Biological Opinion (BO) on the Coordinated Operations of the CVP and SWP* (2008 USFWS CVP/SWP Operations BO) and the NMFS 2009 *Final Biological and Conference Opinion on the Long-Term Operations of the CVP and SWP* (2009 NMFS CVP/SWP Operations BO). Results of this assessment will change the anticipated effects of the No-Action Alternative; however, relative impacts and overall impact mechanisms are not anticipated to change with the results of this assessment. Results of this assessment will be provided in the Final PEIS/R.

Table 4-1.
Projects Included Under No-Action Alternative

Project	Description	Reason for Inclusion in No-Action Alternative
City of Stockton Delta Water Supply Project	Develops a new supplemental water supply for the Stockton metropolitan area by diverting Delta water from a new intake. A raw water pipeline along Eight Mile Road would be built to convey Delta water to a new drinking water treatment plant.	Project is currently authorized, funded, and permitted for implementation
San Joaquin River Exchange Contractors Water Authority Water Transfer Program (2005 – 2014)	Allows the transfer of up to 130,000 acre-feet of substitute water from conservation actions (groundwater pumping and temporary land fallowing from the Exchange Contractors to other CVP contractors) to Reclamation for delivery to San Joaquin Valley wildlife refuges, and to Reclamation and/or DWR for use by the CALFED Environmental Water Account as replacement water for CVP contractors.	Project is currently authorized, funded, and permitted for implementation
Corps Policy on Levee Vegetation	Limits uncontrolled vegetation growth (brush, weeds, or trees) to smaller than 2 inches in diameter to reduce the risk of flood damage.	Flood system improvements are currently underway or will be initiated under this policy (USACE 2007)
Westside Regional Drainage Plan	Implementing the Westside Regional Drainage Plan is assumed to result in the elimination of salt discharges to the San Joaquin River from the Grassland Drainage Area. The Westside Regional Drainage Plan seeks to manage subsurface drainage and achieve a salt balance on productive lands through several mechanisms, including the application of drainage to salt-tolerant crops at a regional reuse facility to reduce the volume of water discharged into Mud Slough (North) and improve the water quality of that discharge.	Plan is currently being implemented
Grassland Bypass Project Extension (2010 – 2019)	Extends the San Luis Drain Use Agreement to allow time to acquire funds and develop feasible drainwater treatment technology to meet revised Basin Plan objectives and waste discharge requirements by December 30, 2019 (consistent with the Westside Regional Drainage Plan and San Luis Drainage Feature Reevaluation plan for drainage service); continues the separation of unusable agricultural drainage water discharged from the Grassland Drainage Area from wetland water supply conveyance channels for 2010 – 2019; facilitates drainage management that maintains the viability of agriculture in the Grassland Bypass Project Area and promotes continuous improvement of water quality in the San Joaquin River.	Final EIS/EIR issued August 2009 extending the project from 2009 to 2019 (Reclamation and SLDMWA 2009)
Semitropic Water Storage District Groundwater Banking Project	Expands current groundwater banking facilities.	Project is currently authorized, funded, and permitted for implementation
Contra Costa Water District Alternative Intake Project	Seeks to reduce effects to Contra Costa WD customers from seasonal fluctuations and changing conditions in the Delta by altering diversion timing and location. The total amount of diversions will not change and no significant impacts to other Delta water users are anticipated.	Project was constructed in 2010; included in Future No-Action Condition of CalSim v.9

Table 4-1.
Projects Included Under the No-Action Alternative (contd.)

Project	Description	Reason for Inclusion in No-Action Alternative
San Joaquin River Agreement and Vernalis Adaptive Management Program 1999 – 2011	Implements the SWRCB 1995 *Water Quality Control Plan* for the lower San Joaquin River and the Delta. VAMP, officially initiated in 2000 as part of SWRCB Water Right Decision 1641, is a large-scale, long-term experimental/management program designed to protect juvenile Chinook salmon migrating from the San Joaquin River through the Delta. VAMP is also a scientific experiment to determine how salmon survival rates change in response to alterations in San Joaquin River flows and CVP/SWP exports with installation of the Head of Old River Barrier. Although VAMP expires in 2011, the No-Action Alternative includes the continued operation of VAMP or a program with similar conditions.	Project is currently authorized, funded, and permitted for implementation; included in Existing Condition and Future No-Action Condition of CalSim v.9
Arvin-Edison Canal Expansion	Increases the capacity of Arvin-Edison WSD South Canal, giving Metropolitan WD of Southern California the ability to withdraw up to 75 TAF of water from Arvin-Edison WSD during dry years and to store up to a total of 350 TAF of SWP water.	Project is currently authorized, funded, and permitted for implementation
Sea level rise of 1 foot because of global warming[1]	Assumption incorporated into a 2006 DWR climate change study that was originally based on an IPCC (2001) investigation.	Included in Future No-Action Condition of CalSim v.9

Note:

[1] Potential future changes due to climate change are reflected in the No-Action Alternative through a sea level rise of 1 foot; other potential changes, such as changes in precipitation and temperature, are explored in the *Sensitivity of Future Central Valley Project and State Water Project Operations to Potential Climate Change and Associated Sea Level Rise* Attachment to Appendix I, "Supplemental Hydrologic and Water Operations Analyses."

Key:
CALFED = California Bay-Delta Program
Corps = U.S. Army Corps of Engineers
CVP = Central Valley Project
Delta = Sacramento-San Joaquin Delta
DWR = California Department of Water Resources
EIR = Environmental Impact Report
EIS = Environmental Impact Statement
IPCC = International Panel on Climate Change
Reclamation = U.S. Department of the Interior, Bureau of Reclamation
SWP = State Water Project
SWRCB = State Water Resources Control Board
TAF = thousand acre-feet
VAMP = Vernalis Adaptive Management Program
WD = Water District
WSD = Water Storage District

4.2 Alternative A1 Reach 4B1 at 475 cfs, Delta Recapture

Alternative A1 includes actions analyzed at both a project and program level. The following discussion includes a subsection describing the project-level actions included in Alternative A1, and a subsection describing program-level actions included in Alternative A1 (see Table 2-2). Two additional subsections describe the Physical Monitoring and Management Plan and the Conservation Strategy, which include both project- and program-level actions intended to guide implementation of the Settlement (see Table 2-2).

4.2.1 Project-Level Actions

Alternative A1 actions analyzed at a project level are described in greater detail below. The Physical Monitoring and Management Plan (Appendix D) and the Conservation Strategy, which include both project- and program-level actions, are described in separate subsections (see Table 2-2).

Alternative A1 actions analyzed at a **project level** and described in more detail below are as follows:

- **Reoperate Friant Dam and Downstream Flow Control Structures –** Actions for reoperating Friant Dam and downstream flow control structures for the release and conveyance of Interim and Restoration flows include the following:
  - Releasing Interim and Restoration flows from Friant Dam up to the Restoration Flows stipulated by the Settlement, as constrained by then-existing channel capacities
  - Minimizing increases in flood risk in the Restoration Area as a result of Interim and Restoration flows
  - Reoperating downstream flow control structures, which includes modifying operations of the San Joaquin River Flood Control Project (flood management system) and other structures to convey Interim and Restoration flows
  - Establishing an RWA and managing Friant Dam to make water supplies available to Friant Division long-term contractors at a preestablished rate

- **Recapture Interim and Restoration Flows –** Alternative A1 includes actions to recapture Interim and Restoration flows within the Restoration Area and/or the Delta using existing facilities, as shown in Figure 4-1 and in Table 2-2. Actions to recapture Interim and Restoration flows in the Restoration Area, and Interim and Restoration Flows in the Delta, are constrained by established regulatory and institutional conditions, with no new facility construction, facility modifications, or agreements. Recaptured water available for transfer to Friant Division long-term contractors under all action alternatives would range from zero to 556 thousand acre-feet (TAF), as shown in Table 4-2. Actions to recapture Interim and Restoration flows under Alternative A1 include the following:

  – Recapture of Interim and Restoration flows in the Restoration Area at Mendota Pool and the East Bear Creek Unit of the San Luis National Wildlife Refuge (NWR) (East Bear Creek Unit)

  – Recapture of Interim and Restoration flows in the Delta at existing CVP/SWP facilities

The following sections describe these project-level actions in greater detail.

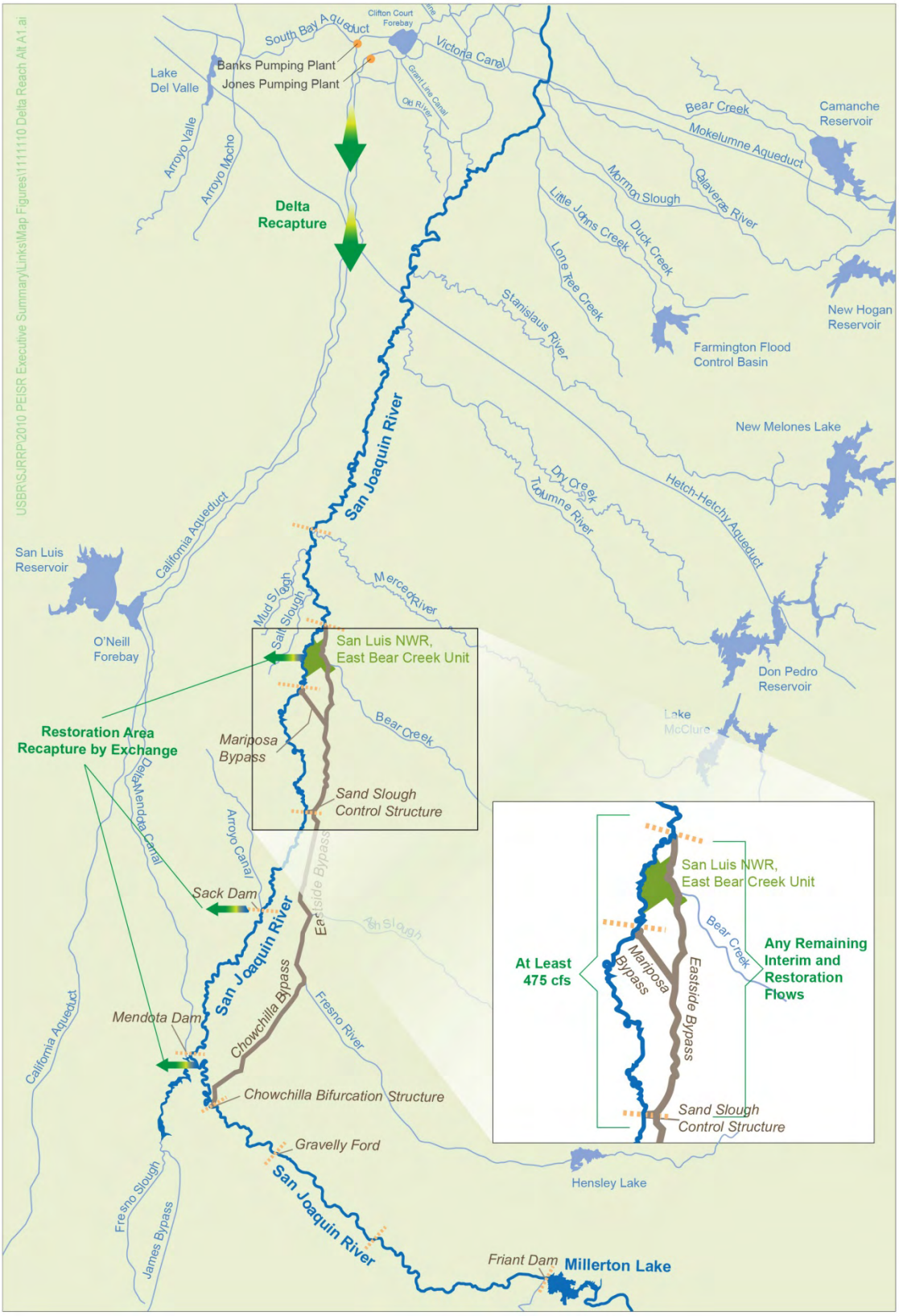


Figure 4-1.
Flow Routing and Water Recapture Under Alternative A1

Table 4-2.
Estimated Maximum Water Available for Transfer Under Action Alternatives

Begin Date	End Date	Friant Dam Releases According to Settlement		Reach 1 Holding Contract Diversions Estimated as in Exhibit B[1]	Friant Dam Releases Eligible for Recapture[1]	
		(cfs)	(TAF)	(cfs)	(cfs)	(TAF)
10/1	10/31	350	22	160	190	12
11/1	11/10	700	14	130	570	11
11/11	12/31	350	35	120	230	23
1/1	2/28	350	41	100	250	29
3/1	3/15	500	14	130	370	10
3/16	3/31	1,500	48	130	1,370	43
4/1	4/15	2,500	74	150	2,350	70
4/16	4/30	4,000	119	150	3,850	115
5/1	6/30	2,000	242	190	1,810	219
7/1	8/31	350	43	230	120	15
9/1	9/30	350	21	210	140	8
Total flows released (TAF)			**673**	**Total available for transfer[2] (TAF)**		**556**
Potential buffer flows (TAF)			67	Potential buffer flows (TAF)		67
Potential additional releases pursuant to Paragraph 13(c)			100	Potential additional releases pursuant to Paragraph 13(c), minus seepage[3]		0
Maximum total volume released (TAF)			**840**	**Maximum total volume available for transfer (TAF)**		**623**

Note:

[1] Under existing conditions, Reclamation makes deliveries to riparian water right holders in Reach 1 under "holding contracts." The amounts in the table are approximate based on recent historical deliveries, as provided in Exhibit B of the Settlement. Water delivered to riparian water right holders would not be eligible for recapture.

[2] Total eligible for recapture is a maximum potential total, and does not account for anticipated losses to seepage or other unanticipated losses.

[3] Paragraph 13(c) requires the acquisition of purchased water to overcome seepage losses not anticipated in Exhibit B. Because these potential releases would only be made to overcome seepage, this water would not be available for transfer.

Key:
cfs = cubic feet per second
TAF = thousand acre-feet

Reoperate Friant Dam and Downstream Flow Control Structures

Reoperation of Friant Dam and downstream control structures includes the release of Interim and Restoration flows, reoperating downstream flow control structures, and establishing a RWA, as stipulated by the Settlement and described in the following sections.

Release Interim and Restoration Flows. The release of Interim and Restoration flows from Friant Dam, an action common to all action alternatives, is analyzed at a project level in this Draft PEIS/R because enough project specificity is available. Operations at Friant Dam would change to release Interim and Restoration flows to the San Joaquin River, according to the six flow schedules specified in Exhibit B of the Settlement, as shown in Figure 4-2. The flow schedules are specified in Exhibit B of the Settlement according to six year types: Critical-Low, Critical-High, Dry, Normal-Dry, Normal-Wet,

and Wet. The total annual unimpaired runoff at Friant Dam for a water year is the index by which the water year type is determined (based on water years 1922 through 2004). The Settlement includes an annual allocation of Interim and Restoration flows using either the Restoration Flow schedules included in Exhibit B of the Settlement, or a more continuous hydrograph, as shown in Figure 4-3, in consideration of recommendations to be made by the RA. Potential alternate pathways for the transformation of allocated Restoration Flows between flow schedules are described in Appendix G, "Plan Formulation." Table 4-3 contains the Settlement-recommended release schedule for Interim and Restoration flows.

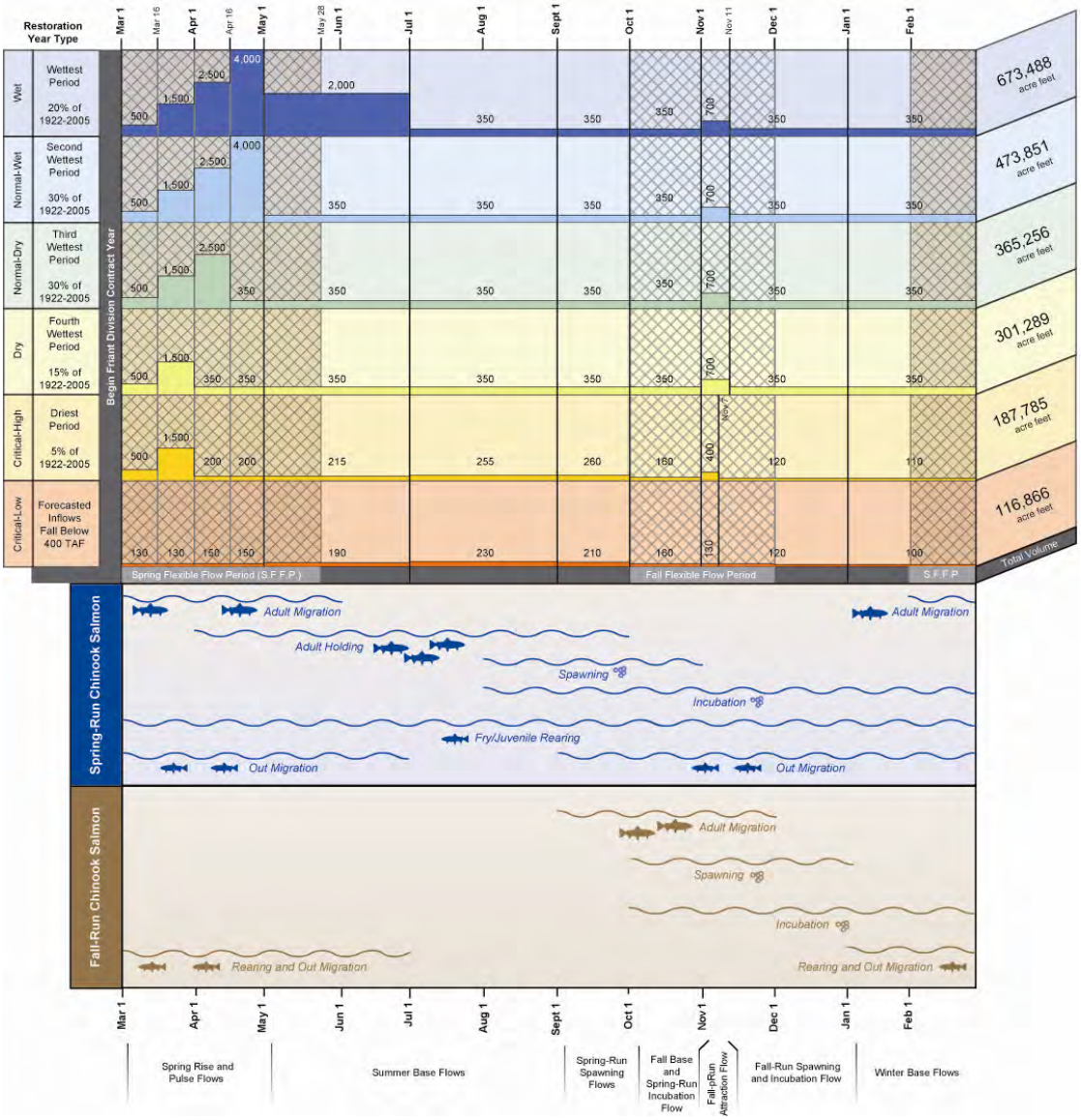
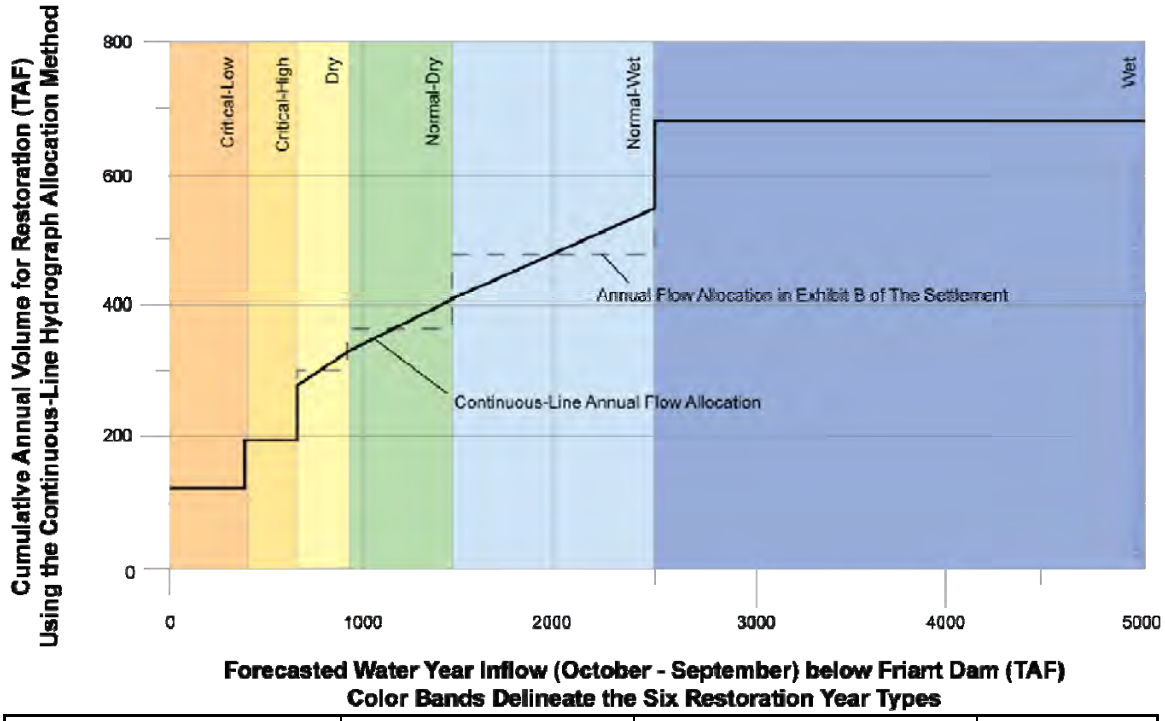


Figure 4-2.
Restoration Flow Schedules Specified in Exhibit B of Settlement



1

Forecasted Water Year Inflow (October – September) Below Friant Dam (TAF)	Annual Flow Allocation in Exhibit B of Settlement[1] (TAF)	Continuous-Line Annual Flow Allocation (TAF)	Restoration Year Type
Less than 400	116.7	116.9	Critical-Low
Greater than 400 to 670	187.5	187.8	Critical-High
Greater than 670 to 930	300.8	272.3 to 330.3	Dry
Greater than 930 to 1,450	364.6	Greater than 330.3 to 400.3	Normal-Dry
Greater than 1,450 to 2,500	473.0	Greater than 400.3 to 574.4	Normal-Wet
Greater than 2,500	672.3	673.5	Wet

Notes:

[1] Friant Dam releases include deliveries to riparian water right holders in Reach 1 under "holding contracts," and releases for the Restoration Goal.

Key:

TAF = thousand acre-feet

2 **Figure 4-3.**

3 **Continuous Annual Restoration Flow Allocation in Alternatives**

4

Table 4-3.
Schedule for Release of Interim and Restoration Flows

Year(s)	Days	Release Flows
2009	October 1 through November 20	Of a timing and magnitude, as defined in the appropriate year type release schedule specified in Exhibit B of the Settlement, and without exceeding then-existing channel capacities[1]
2010	February 1 through December 1	Of a timing and magnitude, as defined in the appropriate year type release schedule specified in Exhibit B of the Settlement, and without exceeding then-existing channel capacities[1]
2011 – 2012	February 1 through May 1	Of a timing and magnitude, as defined in the appropriate year type release schedule specified in Exhibit B of the Settlement, and without exceeding then-existing channel capacities
	May 1 through December 1	To wet the channel down to the Chowchilla Bypass Bifurcation Structure to collect information regarding seepage losses[2]
2012 – 2014	January 1 through December 31	Of a timing and magnitude, as defined in the appropriate year type release schedule specified in Exhibit B of the Settlement, and without exceeding then-existing channel capacities or interfering with any remaining in-channel construction activities; continues until modifications identified in Paragraph 11(a) of the Settlement are completed and full Restoration Flows begin
2014 and later	January 1 through December 31	Of a timing and magnitude, as defined in the appropriate year type release schedule specified in Exhibit B of the Settlement, and without exceeding then-existing channel capacities or interfering with any remaining in-channel construction activities

Notes:

[1] Interim Flows during Water Year 2010 (October 1, 2009, through September 30, 2010) are described in the *Water Year 2010 Interim Flows Project Environmental Assessment/Initial Study* (SJRRP 2009) released by Reclamation and DWR in September 2009. Interim Flows during Water Year 2011 (October 1, 2010, through September 30, 2011) are described in the *Water Year 2011 Interim Flows Project Supplemental Environmental Assessment* (SJRRP 2010) released by Reclamation in September 2010.

[2] This period is intended to correspond to construction activities in Paragraph 11(a). Actual time period of these releases would be coincident with these activities.

Paragraph 15 of the Settlement describes an interim research program that includes the release of Interim Flows beginning in October 2009 and continuing until full Restoration Flows begin (anticipated January 1, 2014), as constrained by then-existing channel capacities). The RA, in consultation with the Technical Advisory Committee, the Secretary, and other appropriate Federal, State, and local agencies, will develop and recommend to the Secretary implementation of a program of Interim Flows. The Interim Flows are intended to allow collection of relevant data concerning flows, temperatures, fish needs, seepage losses, and water recirculation, recapture, and reuse. The Interim Flows include flow releases identified in Exhibit B of the Settlement for the appropriate water year type, including the flexible flow provisions of Exhibit B, to the extent that such releases would not impede or delay completion of actions specified in Paragraph 11(a) of the Settlement, or exceed downstream channel capacities.

The Settlement states that the "Secretary shall commence the Restoration Flows at the earliest possible date…provided, however, that the full Restoration Flows shall commence on a date certain no later than January 1, 2014. If, for any reason, full Restoration Flows are not released in any year beginning January 1, 2014, the Secretary, in consultation with the RA, shall release as much of the Restoration Flows as possible in light of then-existing channel capacity and without delaying completion of the Phase 1 improvements." Paragraph 13(c) of the Settlement identifies procedures to address unexpected seepage losses, including acquiring water or options on water from willing sellers to be utilized for additional releases from Friant Dam.

According to Paragraph 13(i), the RA is responsible for recommending to the Secretary the date for commencing full Restoration Flows in consideration of the completion of Phase 1 improvements (as subsequently described for common Restoration actions). Several Federal and State actions, including channel capacity modifications, are necessary before full Restoration Flows are released. The release of full Restoration Flows is subject to the provisions for flexible flow periods, buffer flows, and purchased water, as well as the provisions described above for Interim Flows. The release and conveyance of full Restoration Flows is defined as meeting Restoration Flow targets at six locations in the Restoration Area identified in Exhibit B of the Settlement, and in consultation with the RA, the six locations are as follows:

- **Friant Dam** – At or immediately below Friant Dam; designated as "Friant Release" in Exhibit B of the Settlement
- **Head of Reach 2A** – At Gravelly Ford; designated as "Reach 2" in Exhibit B of the Settlement
- **Head of Reach 3** – Immediately below the Chowchilla Bypass Bifurcation Structure; designated as "Reach 3" in Exhibit B of the Settlement
- **Head of Reach 4A** – Downstream from Sack Dam; designated as "Reach 4" in Exhibit B of the Settlement
- **Head of Reach 4B** – Designated as "Reach 5" in Exhibit B of the Settlement
- **Confluence of Merced River** – Designated as "Confluence" in Exhibit B of the Settlement

Flow targets vary by Restoration Year Type, and range from zero cfs (in Reaches 3, 4A, and 4B in Critical-Low years) to 4,055 cfs (at the confluence of the Merced River in Wet and Normal-Wet years). In some years, the flow targets could be met partially or entirely by flood control releases or by local runoff or return flows.

If, for any reason, full Restoration Flows are not released in any year, beginning January 1, 2014, the Secretary, in consultation with the RA, would bank, store, exchange, transfer, or sell the water through mutually acceptable agreements with Friant Division long-term contractors or third parties (with proceeds deposited into the Restoration Fund established under the Settlement), or release the water from Friant Dam during times of

the year other than those specified in the applicable flow schedule. In addition, the Settlement includes provisions for the release of pulse flows in Normal-Wet and Wet Years to perform several geomorphic functions such as flushing spawning gravels, unless the Secretary, in consultation with the RA, determines that such flows are not needed. Flushing flows would be accomplished with a quantity of water based on an average flow of 4,000 cfs from April 16 to 30, and include a peak release as close to 8,000 cfs as possible for several hours, within the constraints of channel capacity. The Settlement also includes the following provisions to modify Restoration Flows, in consideration of recommendations to be made by the RA: application of flexible flow periods, as described in Exhibit B of the Settlement; the use of a 10 percent buffer flow to help meet the Restoration Goal; and the release of acquired water for unanticipated river seepage losses for Restoration Flows.

Reclamation and the San Joaquin River Exchange Contractors have entered into a Second Amended Contract for Exchange of Waters (Contract Ilr-1144) (San Joaquin River Exchange Contract), dated February 14, 1968. Under the terms and conditions of that contract, Reclamation is obligated to make available required deliveries from the Delta-Mendota Canal (DMC) or releases from Millerton Reservoir. If Reclamation makes deliveries to the San Joaquin River Exchange Contractors via the San Joaquin River, these water deliveries would have a higher priority for channel capacity over Interim or Restoration flows. Therefore, Interim and Restoration flows would be reduced, as necessary, to provide channel capacity for water delivery to the San Joaquin River Exchange Contractors via the San Joaquin River. However, it is important to note that under Article 3(n) of the Friant Division long-term water service contracts and the recently executed Friant Division repayment contracts, "The United States agrees that it will not deliver to the Exchange Contractors thereunder waters of the San Joaquin River unless and until required by the terms of said contract, and the United States further agrees that it will not voluntarily and knowingly determine itself unable to deliver to the Exchange Contractors entitled thereto from water that is available or that may become available to it from the Sacramento River and its tributaries or the Sacramento-San Joaquin Delta those quantities required to satisfy the obligations of the United States under said Exchange Contract and under Schedule 2 of the Contract for Purchase of Miller and Lux Water Rights (Contract I1r-1145, dated July 27, 1939)."

Minimize Flood Risk from Interim and Restoration Flows. Throughout Settlement implementation, the maximum downstream extent and rate of Interim and Restoration flows to be released would be limited to then-existing channel capacities. As channel or structure modifications are completed with additional environmental compliance, maximum Interim Flow releases would be correspondingly increased in accordance with then-existing channel capacities and with the release schedule. Consistent with the Act, Interim Flows would be reduced, as needed, to address material seepage impacts, as identified through the monitoring program (see Appendix D, “Physical Monitoring and Management Plan”). If release of water from Friant Dam is required for flood control purposes, concurrent Interim and Restoration flows would be reduced by an amount equivalent to the required flood control release. If flood control releases from Friant exceed the concurrent scheduled Interim and Restoration flows, no additional releases above those required for flood control would be made for SJRRP purposes.

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

- **Establish a Channel Capacity Advisory Group and Determine and Update Estimates of Then-Existing Channel Capacities as Needed –** The establishment and administration of a Channel Capacity Advisory Group to provide independent review of estimated then-existing channel capacities, monitoring results, and management actions to address vegetation and sediment transport within the system as identified by Reclamation.

- **Maintain Interim and Restoration Flows Below Estimates of Then-Existing Channel Capacities –** The process for limiting Interim and Restoration flows to reduce the risk of levee failure due to underseepage, through-seepage, and associated levee stability issues to less-than-significant levels.

- **Closely Monitor Erosion and Perform Maintenance and/or Reduce Interim and Restoration Flows as Necessary to Avoid Erosion-Related Impacts** – The commitment by Reclamation to implement erosion monitoring and management, including monitoring potential erosion sites, reducing Interim and Restoration flows as necessary, and reporting ongoing results of monitoring and management actions to the Channel Capacity Advisory Group.

Only limited data are currently available on San Joaquin River channel capacities and levee conditions. The levee design criteria developed by U.S. Army Corps of Engineers (USACE) and presented in *Design and Construction of Levees Engineering and Design Manual* (Manual No. 1110-2-1913) (USACE 2000) would be applied throughout the Restoration Area to identify the Interim or Restoration flows that would not cause the "Factor of Safety" to be reduced below 1.4, as calculated using USACE levee criteria shown in Table 4-4. The application of the Factor of Safety of 1.4 is required for federally authorized flood control projects. As defined by USACE, the Factor of Safety is equal to one over the exit gradient, as measured at the toe of the levee (2000).

Until adequate data are available to determine the Factor of Safety, Reclamation would limit the release of Interim and Restoration flows to those which would remain in-channel. In-channel flows are flows that maintain a water surface elevation at or below the elevation of the landside levee toe (i.e., the base of the levee). When sufficient data are available to determine the Factor of Safety, Reclamation would limit Interim and Restoration flows to levels that would correspond to a Factor of Safety of 1.4 or higher at all times. Observation of levee erosion, seepage, boils, impaired emergency levee access, or other indications of increased flood risk identified through ongoing monitoring at potential erosion sites would indicate that the minimum Factor of Safety is not met and would trigger immediate reductions in Interim and Restoration flows at the site. Such observations would supersede channel capacity estimates, and Interim and Restoration flows would be reduced in areas where these conditions occur. Potential immediate responses to reduce, redirect, or redivert Interim or Restoration flows to reduce flow in downstream reaches is described in Section 2.4.3.

Detailed discussion of these three measures to reduce flood risk from the release and conveyance of Interim and Restoration flows is presented below.

Table 4-4.
Minimum Factors of Safety - Levee Slope Stability

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

Notes:

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

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

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

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

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

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

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

Establish a Channel Capacity Advisory Group, and Determine and Update Estimates of Channel Capacities as Needed. In coordination with DWR and prior to releasing Interim Flows in Water Year 2013, Reclamation would establish a Channel Capacity Advisory Group to provide independent review of then-existing channel capacities estimated by Reclamation in accordance with standard USACE levee performance criteria. The Channel Capacity Advisory Group would be responsible for providing timely independent review of data, analytical methodology, and results used to estimate then-existing channel capacities. The Channel Capacity Advisory Group would be comprised of the following:

- One member from the U.S. Bureau of Reclamation
- One member from the California Department of Water Resources
- One member from the U.S. Army Corps of Engineers
- One member from the Lower San Joaquin Levee District
- One member from the Central Valley Flood Protection Board

Reclamation would prepare a report annually or whenever Reclamation contemplates increasing the upper limit of releases for Interim or Restoration flows, which would include data and methods used to develop estimates of then-existing channel capacities. A draft report would be provided to the Channel Capacity Advisory Group for its review and comment for a period of 60 days. In the event that comments or recommendations are received from the Advisory Group within 60 days, Reclamation would be required to consider and respond to such comments and prepare a final report for distribution to the Channel Capacity Advisory Group within 60 days of the close of the draft report review period. Reclamation would not increase Interim or Restoration flows above the previously determined then-existing channel capacities until 10 days after the final report is prepared and distributed to the Channel Capacity Advisory Group. The first draft report shall be completed within 1 year of signing the PEIS/R Record of Decision. Draft reports would include the data, methods, and estimated channel capacities; flow limits and any maintenance activities; and monitoring efforts and management actions as described in this project description. Draft and final reports would be made available to the public concurrent with their distribution to the Channel Capacity Advisory Group.

Reclamation would convene the Channel Capacity Advisory Group as required until 2030, but may stop earlier, provided that then-existing channel capacities are determined to equal or exceed the maximum proposed Restoration Flows throughout the Restoration Area. If after 2030 then-existing channel capacities decrease such that full Restoration Flows cannot be conveyed, the Channel Capacity Advisory Group would be reconvened and function as described above until such time that the then-existing channel capacities are determined to equal or exceed the full Restoration Flows.

Maintain Interim and Restoration Flows at or Below Estimated Then-Existing Channel Capacities. Until sufficient data are available to determine the Factor of Safety, Reclamation would limit initial Interim and Restoration flow releases to those flows which would remain in-channel, as described below. When sufficient data are available to determine the Factor of Safety, Reclamation would limit the release of Interim and

Restoration Flows to those flows which would maintain standard USACE levee performance criteria (i.e., a Factor of Safety of at least 1.4) at all times.

In coordination with DWR, Reclamation would apply standard USACE levee performance criteria for levees under a steady state of saturation and consider past performance and hydrologic and hydraulic modeling to determine and update estimates of channel capacities. The resulting estimated channel capacities would be used to establish limits for Interim and Restoration flows throughout the Restoration Area. Reclamation would be required to provide this estimate to the Channel Capacity Advisory Group for review, as previously described.

In the event that insufficient information is available to develop an estimate of channel capacities that maintain a minimum Factor of Safety for levees under saturated conditions by Water Year 2013, Reclamation would limit initial Interim and Restoration flows to those flows which would remain in-channel, as determined by DWR using one-dimensional HEC-RAS hydraulic modeling and described in Appendix I of this Draft PEIS/R. In-channel flows would have less-than-significant effects on flood risk as explained in the PEIS/R impact assessment of in-channel flows.

Factors of Safety are inversely related to the exit gradient, and describe the potential for unsafe conditions to occur. The exit gradient is the hydraulic gradient at which water leaves the soil surface under saturated conditions, and is a function of both structural design and hydrogeologic conditions. At a critical exit gradient, soil particles may move with water, resulting in unsafe conditions such as piping and boils (Craig 1997, USACE 2000). USACE recommends a Factor of Safety of 1.4 or greater for levees under a steady state of saturation for a prolonged time, such as occurs during flood conditions or with prolonged flows. Maintaining the USACE levee performance criteria for levees under a steady state of saturation would be the key levee performance criterion for maintaining flood risks at less-than-significant levels.

Systematic levee condition monitoring would be implemented as described in more detail in Appendix D, “Physical Monitoring and Management Plan.” Observation of seepage or boils at the landside levee toe or evidence of levee erosion would indicate that the minimum Factor of Safety is not met. Such observations would supersede channel capacity estimates, and Interim and Restoration flows would be immediately reduced, redirected, or diverted in areas where these conditions occur (see Section 2.3.4).

Closely Monitor Erosion and Perform Maintenance and/or Reduce Interim or Restoration Flows as Necessary to Avoid Erosion-Related Impacts. As part of the draft reports prepared by Reclamation and submitted to the Channel Capacity Advisory Group (as described previously), Reclamation would describe the monitoring and management actions taken within the Restoration Area over the prior year and the monitoring and management actions planned for the following year. The draft reports would identify those monitoring and management actions that are a result of implementing the Settlement and those that are a result of regular operation and maintenance and capital improvements of the Lower San Joaquin River Flood Control Project. The draft reports

would be submitted to the Channel Capacity Advisory Group for review as previously described.

Reclamation would implement the flood-related monitoring and management actions included in the project description and in the draft reports to the Channel Capacity Advisory Group, and would work with the appropriate agency(ies) to implement these actions to meet the performance standards as previously described. As previously described, systematic levee condition monitoring would be implemented as described in more detail in Appendix D, "Physical Monitoring and Management Plan," and could lead to the immediate reduction of Interim or Restoration flows in areas where these conditions occur.

Erosion monitoring would be conducted by Reclamation using several standard methodologies and protocols commonly employed by DWR, reclamation districts, and/or USACE to monitor levee erosion. Aerial photography and/or ground surveys would be compared to identify changes in bank line over time, indicating potential erosion. True color aerial photographs would be inspected and compared to previous aerial photographs to identify areas of sediment mobilization, bar formation, and bank erosion. After these areas have been initially identified using aerial photography, they would be visited and inspected. If inspections indicate that erosion-related impacts exist or are imminent, management actions would be taken to address the issue.

Field surveys of potential erosion sites on the San Joaquin River between Friant Dam and the Merced River confluence would be conducted by Reclamation annually. These surveys would assess the condition of potential erosion sites, and could include a variety of techniques such as aerial photography and topographic surveys. Previous information documents the existing sediment and geomorphology conditions within the Restoration Area. Existing information developed by Reclamation includes preliminary analyses conducted to identify locations susceptible to potential erosion through comparison of present-day channel positions (2004) and historical channel positions (1937, 1938). Reclamation identified areas that may be susceptible to future erosion using the following criteria:

- Areas of channel change between 1937 and 2004 or between 1983 and 2004 where the channel has shown lateral erosion along an outer bend or where it has the potential to reoccupy an old channel position and laterally erode banks along an outer bend, and that also have low topography (for instance, several outer bends in Reach 1A are located adjacent to high bluffs, which would be considered an area of slower erosion and are thus not identified).

- Meander necks where channel sinuosity is high and could create a cutoff.

- Areas along outer bends where excavated gravel pits are located close to the active channel, regardless of whether any historical channel change has occurred.

- Areas along outer bends that are located adjacent to developed areas (such as at Firebaugh).

- Areas with the potential for future erosion identified through this process and prioritized for monitoring based on potential impacts to infrastructure. The highest priorities were those with residential developments, buildings, and bridges. Other high-priority areas included those containing levees, irrigation canals, and roads with an apparent high potential to experience some lateral migration or bank erosion.

Sediment mobilization monitoring during these annual surveys would focus on specific potential erosion sites identified through this process, and would evaluate current and potential future erosion at these sites. Channel bed deposition would be evaluated as necessary by analyzing changes identified in topographic survey data and LIDAR surveys.

The Lower San Joaquin Levee District (LSJLD) and the Central Valley Flood Protection Board (CVFPB) currently have the responsibility for implementing routine operation and maintenance or capital improvements to the Lower San Joaquin River Flood Control Project.

Erosion management actions identified through monitoring as described above may fall under the routine maintenance of the Lower San Joaquin River Flood Control Project currently performed by LSJLD. If increased maintenance activities and costs are required as a result of implementing the Settlement, including additional erosion management actions identified through the monitoring activities described in this section, Reclamation would conduct or enter into an agreement with others to conduct such additional maintenance activities. Currently, Reclamation is working with LSJLD to develop and implement an agreement to provide financial assistance for additional costs incurred by LSJLD. The financial assistance agreement is intended to assist LSJLD in adapting to changes in operations and maintenance activities, as needed to maintain the existing level of flood management under release of Interim and Restoration flows.

Reoperate Downstream Flow Control Structures. In addition to management of Interim and Restoration flows at Friant Dam, Alternative A1 includes modifications to the existing operation of the Lower San Joaquin River Flood Control Project (flood management system) and the Hills Ferry Barrier, but without physical, construction-related activities to modify the channels, to address the following:

- **Reoperate Chowchilla Bypass Bifurcation Structure to convey Restoration Flows into Reach 2B –** Currently, the structure is operated as part of the flood management system to direct flood flows and irrigation deliveries based on several factors, including flows in Reach 2A, the capacity of Reach 2B, flows from the Kings River system via Fresno Slough, and water demands in the Mendota Pool. Modifications to the operating criteria would incorporate the routing of Interim and Restoration flows during nonflood operations to meet flow targets in Reach 2B. If flood releases are made from Friant Dam in excess of the Interim or Restoration flows called for, Interim and Restoration flows would not be released and standard operation of the flood management system would apply. Interim and Restoration flows would have a lower priority for downstream

channel capacity than flood flows or irrigation deliveries to the San Joaquin River Exchange Contractors.

- **Reoperate San Joaquin River Headgate Structure to convey Restoration Flows into Reach 4B1 –** The current conveyance capacity of Reach 4B1 is unknown and could be as low as zero in some locations. Currently, the San Joaquin River Headgate Structure, part of the flood management system, is maintained in a closed position whereby all flows in the river are routed into the bypass system. The San Joaquin River Headgate Structure would be operated to release Interim and Restoration flows to Reach 4B1 after completion of modifications to provide for increased capacity in Reach 4B1, and modifications to the headgate structure are completed. These releases would be limited by then-existing channel capacity in Reach 4B1.

- **Reoperate the Eastside and Mariposa bypass bifurcation structures to convey Interim and Restoration flows into Reach 4B2 –** Modifications to the operating criteria for these structures, which are part of the flood management system, would include the routing Interim and Restoration flows to the Eastside or Mariposa bypasses. Interim and Restoration flows would have a lower priority for downstream channel capacity than flood flows.

- **Operate and monitor Hills Ferry Barrier –** The main purpose of the Hills Ferry Barrier is to redirect upstream-migrating adult fall-run Chinook salmon into suitable spawning habitat in the Merced River and prevent migration into the main stem San Joaquin River upstream, where conditions are currently considered unsuitable for Chinook salmon and Central Valley steelhead. The adult Central Valley steelhead migration period overlaps with fall-run Chinook salmon, and typically occurs between October and December in the San Joaquin River basin. Because their body type is similar to salmon, Central Valley steelhead would be expected to be redirected by the barrier in a similarly effective manner. Operations and maintenance of the Hills Ferry Barrier would continue for the purpose of redirecting Chinook salmon and, incidentally, Central Valley steelhead until sufficient habitat and channel improvements to support salmonids are complete.

Establish Recovered Water Account and Program. The release of Interim and Restoration flows would reduce annual water deliveries to Friant Division long-term contractors. Consistent with Paragraph 16(b) of the Settlement, Reclamation would identify delivery reductions to Friant Division long-term contractors associated with the release of Interim and Restoration flows, as part of the RWA stipulated for implementation under Paragraph 16(b). Paragraph 16(b) also provides for the delivery of water during wet hydrologic conditions to Friant Division long-term contractors at a cost of $10 per acre-foot. Implementing Paragraph 16(b) actions could affect the amount of water that is released to the San Joaquin River in excess of Restoration Flow requirements during wet periods. The diversion of water from Friant Dam pursuant to Paragraph 16(b) would be based on the following conditions:

- Water at Friant Dam would be eligible for delivery to Friant Division long-term contractors, pursuant to Paragraph 16(b), in wet hydrologic conditions when water is not needed for Interim and Restoration flows.

- Paragraph 16(b) water would be conveyed through the Friant-Kern and Madera canals only when capacity is available, without impacting requirements to meet existing contract deliveries to Friant Division long-term contractors.

- Potential future demand for Paragraph 16(b) water in all action alternatives is based in part on the implementation of actions by Friant Division long-term contractors or other water users to increase surface water conveyance or groundwater recharge capacity.

It is anticipated that Friant Division long-term contractors would be able to accept delivery of some Paragraph 16(b) water using existing water conveyance and storage facilities. Because Paragraph 16(b) water would likely be available predominantly during periods when irrigation demand is limited, it is expected that Friant Division and non-Friant Division water users could develop additional local conveyance and storage capacity to increase their ability to receive Paragraph 16(b) water supplies. The program alternatives are evaluated in consideration of the range of potential changes in water diversions that could result from implementing water facility improvements in the Friant Division to increase delivery capability. Facility improvements to increase delivery capability would require separate environmental compliance documentation, and are not included as actions under the program alternatives. Pursuant to Part III of the Omnibus Public Land Management Act of 2009 (Public Law 111-11), the Secretary is developing proposed guidelines for projects designed to reduce, avoid, or offset the quantity of expected water supply impacts to Friant Division long-term contractors caused by Interim and Restoration flows. This process is occurring parallel to and separate from development of this Draft PEIS/R.

Reclamation is currently working with the Friant Division long-term contractors and appropriate agencies to develop procedures for identifying delivery reductions to Friant Division long-term contractors associated with the release of Interim and Restoration flows as part of the RWA stipulated for implementation under Paragraph 16(b).

Recapture Interim and Restoration Flows

Water recapture actions in Alternative A1 include recapturing Interim and Restoration flows using existing facilities in the Restoration Area and in the Delta. These actions are analyzed at a project level in this Draft PEIS/R. As described previously, action alternatives presented in this Draft PEIS/R are differentiated, in part, by the actions for recapturing Interim and Restoration flows. Recaptured water available for transfer to Friant Division long-term contractors would range from zero to 556 TAF, as shown in Table 4-2. Reclamation would identify actual delivery reductions to Friant Division long-term contractors associated with the release of Interim and Restoration flows.

Recapture in the Restoration Area. Alternative A1, and all other action alternatives, includes potential recapture of up to the total quantity of Interim and Restoration flows (556 TAF, as shown in Table 4-2) within the Restoration Area using existing facilities. As previously described, the Settlement includes flow targets in six locations to determine achievement of the Restoration Goal. Paragraph 16(a)(1) of the Settlement provides that recapture and recirculation of Interim and Restoration Flows "shall have no adverse impact on the Restoration Goal, downstream water quality or fisheries," Because recapture within the Restoration Area could prevent the flow targets from being met, recapture within the Restoration Area would occur only if necessary to avoid interfering with in-channel construction activities associated with the Restoration Goal, or to avoid potential material adverse impacts from groundwater seepage (as described in Appendix D, "Physical Monitoring and Management Plan") or for other emergency actions to avoid immediate adverse impacts. Interim and Restoration flows would be recaptured consistent with Federal, State, and local laws, and future agreements with downstream agencies, entities, and landowners. Potential locations within the Restoration Area for recapture of Interim and Restoration flows include the Mendota Pool, and the East Bear Creek Unit located in Eastside Bypass Reach 3. Only diversion facilities that have potential to recirculate Interim and Restoration flows to the Friant Division would be used for recapture locations.

No change in operational requirements would be required to recapture Interim and Restoration flows in the Restoration Area or in the Delta under the regulatory compliance standards in place at the time water is recaptured. Any increase in Restoration Area or Delta exports directly resulting from the Interim or Restoration flows would be available for recirculation to the Friant Division; however, recirculation of recaptured water to the Friant Division could require subsequent exchange agreements between Reclamation, DWR, Friant Division long-term contractors, and other south-of-Delta CVP/SWP contractors who are not included in the action alternatives. As previously described, recirculation would be subject to available capacity and existing operational constraints within CVP/SWP storage and conveyance facilities.

Locations available for recapture of Interim and Restoration flows within the Restoration Area include the following:

- **Recapture at Mendota Pool** – Interim and Restoration flows could be diverted from the Mendota Pool to the extent that these flows would meet demands, replacing CVP water supplies that would otherwise be delivered via the DMC. The DMC carries water from the Delta to the Mendota Pool, where the water is diverted through several existing pumps and canals with a combined capacity that exceeds upstream channel capacity. Interim and Restoration flows diverted by CVP contractors at the Mendota Pool would be in lieu of supplies typically delivered via the DMC. Therefore, CVP water supplies that would have been delivered via the DMC would be made available for delivery to the Friant Division, subject to existing contractual obligations and existing and any future agreements. In such cases, Delta exports would not change compared to the No-Action Alternative. Exported water, up to the amount diverted at the Mendota Pool, would be available for recirculation to the Friant Division using existing

south-of-Delta facilities, including the C.W. "Bill" Jones Pumping Plant (Jones Pumping Plant) and Harvey O. Banks Pumping Plant (Banks Pumping Plant), California Aqueduct, DMC, San Luis Reservoir and related pumping facilities, and other facilities operated by CVP/SWP contractors, as shown on Figure 4-4.

- **Recapture at wildlife refuge** – If considerations in Reach 5 or in downstream reaches (such as channel capacity or potential take of listed species that could not be avoided) require that less (or no) flow enters those reaches, Interim and Restoration flows could be diverted to the East Bear Creek Unit in Eastside Bypass Reach 3, to the extent that these flows would meet water supply demands. The East Bear Creek Unit has a pump lift station in the Eastside Bypass with a diversion capacity of 60 cfs. This pump station includes a 48-inch-diameter intake structure and four 125-horsepower electric motors driving 15 cfs pumps. Deliveries of Interim and/or Restoration Flows to the East Bear Creek Unit would be further constrained by actual demand for water supplies at the units. Currently, the East Bear Creek Unit receives CVP water supplies from the DMC.

Recapture in Delta. Interim and Restoration flows reaching the Delta would be recaptured at existing facilities within the Delta consistent with applicable laws, regulations, BOs, and court orders in place at the time the water is recaptured. Alternative A1 includes recapture of Interim and Restoration flows in the Delta at the Jones and Banks pumping plants (Figures 2-2 and 2-4), operated consistent with applicable laws, regulations, BOs, and court orders in place at the time the water is recaptured.

Key: P.P. = Pumping Plant

Figure 4-4.
Major Facilities That May Be Used in Recapture and Recirculation of Interim and Restoration Flows

4.2.2 Program-Level Actions

Alternative A1 actions analyzed at a program level are described below, and include recirculating recaptured Interim and Restoration flows, and common Restoration actions. The Physical Monitoring and Management Plan (Appendix D) and the Conservation Strategy, which include both project- and program-level actions, are described in a separate subsection.

Alternative A1 actions analyzed in this Draft PEIS/R at a **program level** and described in more detail below are as follows:

- **Recirculate recaptured Interim and Restoration flows** – Alternative A1 includes recirculating up to the full amount of recaptured Interim and Restoration flows to the Friant Division to minimize water supply impacts to Friant Division long-term contractors caused by Interim and Restoration flows.

- **Common Restoration actions –** Common Restoration actions are potential physical actions to achieve the Restoration Goal that are common to all action alternatives, and which would be implemented within the Restoration Area, as shown in Figure 4-5. These include actions to modify Reach 4B1 to convey at least 475 cfs of Interim and Restoration flows. Modifications in the Eastside and Mariposa bypasses to convey Interim and Restoration flows in excess of flows routed through Reach 4B1 are common to all alternatives, as shown in Figure 2-2, and are described as part of the common Restoration actions.

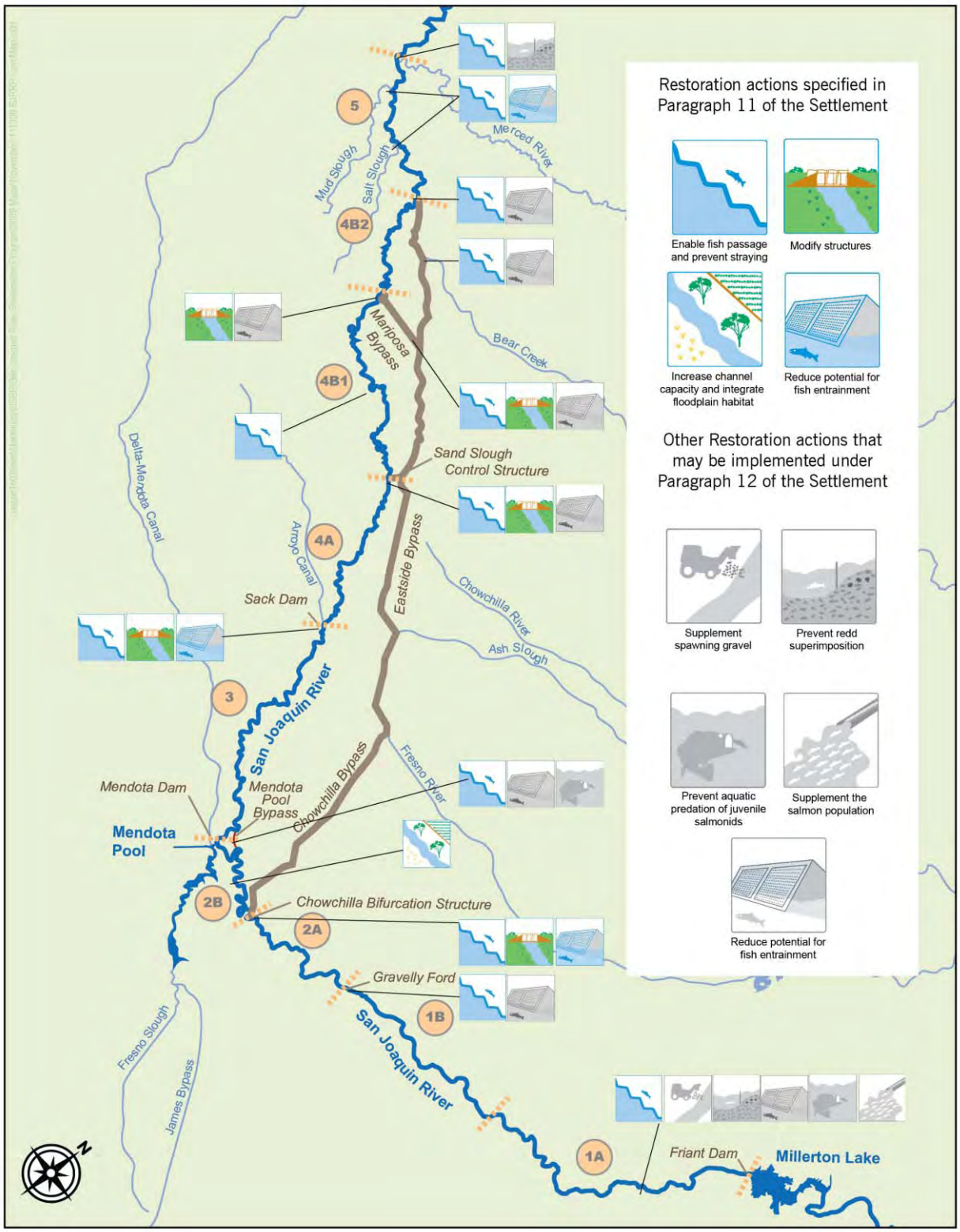


Figure 4-5.
Location of Common Restoration Actions Included in Action Alternatives

Recirculate Recaptured Interim and Restoration Flows

Paragraph 16(a) of the Settlement stipulates that the Secretary, in consultation with the Settling Parties, is to develop and implement "…a plan 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 Flows and Restoration Flows," provided "…that any recirculation, recapture, reuse, exchange or transfer of the Interim and Restoration flows shall have no adverse impact on the Restoration Goal, downstream water quality or fisheries." The quantity of water available for recirculation to the Friant Division long-term contractors would be up to the amount of water recaptured at existing facilities (under all alternatives) or new or modified facilities (Alternatives C1 and C2). Water recaptured and recirculated to the Friant Division in this manner could require exchange agreements between Reclamation, DWR, Friant Division long-term contractors, and other south-of-Delta CVP/SWP contractors. The details of the plan for recirculation would be determined through future negotiations between affected parties, and this action is therefore described at a program level in this Draft PEIS/R.

Recirculation would be subject to available capacity within CVP/SWP storage and conveyance facilities. Available capacity is capacity that is left after satisfying all statutory and contractual obligations to existing water service or supply contracts, exchange contracts, settlement contracts, transfers, or other agreements involving or intended to benefit CVP/SWP contractors served water through CVP/SWP facilities. No additional agreements would be required to recapture Interim and Restoration flows in the Restoration Area. However, recirculation of recaptured water to the Friant Division could require mutual agreements between Reclamation, DWR, Friant Division long-term contractors, and other south-of-Delta CVP/SWP contractors. Reclamation would develop these agreements in close coordination with Friant Division long-term contractors. Any mutual agreements negotiated to facilitate delivery of water to Friant Division contractors using CVP/SWP facilities would be negotiated so as not to impact CVP/SWP deliveries or operation of the CVP/SWP; such agreements may require additional environmental documentation. In addition, Paragraph 13(i) of the Settlement provides guidance on how to manage any unreleased Restoration Flows starting in 2014, including but not limited options to enter into mutually acceptable agreements with Friant Division long-term contractors or third parties, "…to (A) bank, store, or exchange such water for future use to supplement future Restoration Flows, or (B) transfer or sell such water and deposit the proceeds of such transfer or sale into the Restoration Fund created by this Settlement." Paragraph 13(i) also specifies the release the water from Friant dam during times of the year other than those specified in the applicable hydrograph. Any mutual agreements negotiated to facilitate the actions under Paragraph 13(i) would be negotiated so as not to increase water supply reductions to Friant Division long-term contractors beyond what would have been caused by releases in accordance with the hydrograph releases in Exhibit B of the Settlement. Such agreements may require additional environmental documentation.

Common Restoration Actions

Common Restoration actions require program-level coverage to address cumulative and system-wide effects, and include actions stipulated in Paragraphs 11 and 14 of the Settlement, as well as additional structural or channel improvements that may further enhance the success of achieving the Restoration Goal under Paragraph 12 of the Settlement.

- **Paragraph 11(a).** Common Restoration actions stipulated in Paragraph 11 of the Settlement include channel modifications to be completed in two phases. Phase 1 actions are the 10 actions stipulated in Paragraph 11(a) of the Settlement that are considered the highest priority channel improvements. The Settlement stipulates that those actions be completed by December 31, 2013. Two potential actions require subsequent decisions to determine their necessity: (1) modifications to the San Joaquin River Headgate Structure at the head of Reach 4B1, and (2) modifications in the Eastside and Mariposa bypasses to provide fish passage under low flows. In the following sections, these 10 Phase 1 actions are grouped by common location and/or other linkages, and include the following:

  - **Paragraphs 11(a)(1) and 11(a)(2)** – Construct Mendota Pool Bypass and Modify Reach 2B to convey at least 4,500 cfs
  - **Paragraph 11(a)(3)** – Modify Reach Reach 4B1 to convey at least 475 cfs
  - **Paragraph 11(a)(4)** – Modify San Joaquin River Headgate Structure to enable fish passage
  - **Paragraph 11(a)(5)** – Modify Sand Slough Control Structure to enable fish passage and flow routing
  - **Paragraphs 11(a)(6) and 11(a)(7)** – Screen Arroyo Canal and provide fish passage at Sack Dam
  - **Paragraphs 11(a)(8) and 11(a)(9)** – Modify Eastside and Mariposa bypasses to enable fish passage
  - **Paragraph 11(a)(10)** – Enable deployment of seasonal barriers at Mud and Salt sloughs

- **Paragraph 11(b).** The four Phase 2 actions stipulated in Paragraph 11(b) of the Settlement also are considered high priority channel improvements that may contribute to achieving the Restoration Goal. The Settlement stipulates that these projects be completed by December 31, 2016, in a manner that does not delay completion of Phase 1 actions. Subsequent decisions would be required to determine whether the Phase 2 actions are necessary and, if so, to define the scope of the actions. Phase 2 actions not included in Alternative A1 involve modifications to enable routing of up to 4,500 cfs into and through Reach 4B1, as

described for Alternative A2. The following Phase 2 actions included in Alternative A1 are described in the following sections:

  - **Paragraph 11(b)(2)** – Modify Chowchilla Bypass Bifurcation Structure
  - **Paragraph 11(b)(3)** – Fill or isolate gravel pits

- **Paragraph 14.** Paragraph 14 of the Settlement stipulates that spring-run and fall-run Chinook salmon reintroduction occur by December 31, 2012.

- **Paragraph 12.** Paragraph 12 states that additional structural or channel improvements that may further enhance the success of achieving the Restoration Goal may be recommended by the RA to the Secretary for implementation. Potential actions under Paragraph 12 are not assigned a date for completion under the Settlement. Site-specific studies and subsequent implementation of future potential Restoration actions under Paragraph 12 of the Settlement would be based on information collected through monitoring, as identified in the Physical Monitoring and Management Plan (Appendix D), during implementation of Settlement-stipulated actions. Potential Restoration actions pursuant to Paragraph 12 that could be identified by the RA at a future date range from no modifications to the level of implementation described below. Appendix E, "Fisheries Management Plan," addresses specific actions, including those described below, and evaluates their merits (including uncertainty) in an action routing process. The following potential Paragraph 12 actions included in Alternative A1 are described in the following sections:

  - Enhance Spawning Gravel
  - Reduce Potential for Redd Superimposition and/or Hybridization
  - Supplement Salmon Population
  - Modify Floodplain and Side-Channel Habitat
  - Enhance In-Channel Habitat
  - Reduce Potential for Aquatic Predation of Juvenile Salmonids
  - Reduce Potential for Fish Entrainment
  - Enable Fish Passage
  - Modify Flood Flow Control Structures

All alternatives include the anticipated range of potential implementation for common actions under Paragraphs 11, 14, and 12 of the Settlement, as described below and shown in Figure 4-5. All common Restoration actions would require future, separate project-specific planning studies and NEPA and/or CEQA documentation analyzing the effects of implementation. The details described below for these actions are based on initial engineering concepts and information from the Fishery Management Plan (Appendix E). These details are subject to change as additional project-specific information is developed.

Common Restoration actions include modifications to the channel and flow control structures, including levees and other portions of the Lower San Joaquin Flood Control Project. As part of any modifications that could affect operation of the Lower San Joaquin Flood Control Project, the lead agencies would conduct a study to determine needed conveyance modifications, including modifications to levees and other related hydraulic features, to maintain existing levels of flood protection. Channel and facility modifications would be designed to not adversely affect flood conveyance capacity or functionality of existing channels and facilities.

Construct Mendota Pool Bypass and Modify Reach 2B. Paragraph 11(a)(1) of the Settlement stipulates the creation of a bypass channel around the Mendota Pool to convey at least 4,500 cfs from Reach 2B downstream to Reach 3. Paragraph 11(a)(2) of the Settlement stipulates modifications in channel capacity, and incorporation of new floodplain habitat and related riparian habitat, to convey at least 4,500 cfs between the Chowchilla Bypass Bifurcation Structure and new Mendota Pool Bypass. Because the functions of these channels are related, they are described together in this section:

- **Construct Mendota Pool Bypass –** Constructing Mendota Pool Bypass includes building a bypass around the Mendota Pool to convey at least 4,500 cfs from Reach 2B to Reach 3 downstream from Mendota Dam. Riparian habitat in the Mendota Pool Bypass is expected to be similar to new floodplain habitat in Reach 2B. Constructing the Mendota Pool Bypass also includes constructing a bifurcation structure in Reach 2B to convey at least 4,500 cfs to the bypass. The bifurcation structure would include a fish screen or other positive fish barrier to direct fish into the bypass channel and minimize or avoid fish passage from Reach 2B to the Mendota Pool. Additionally, the Mendota Pool Bypass would include one or more grade control structures to control bedform and create stable and suitable habitat conditions for fish in the vicinity.

- **Modify Reach 2B to convey at least 4,500 cfs –** Modifying Reach 2B to convey at least 4,500 cfs includes expanding the capacity of the reach to convey at least 4,500 cfs, with integrated floodplain habitat. New levees would be constructed, potentially along either or both sides of Reach 2B, to create an average floodplain width of between 500 feet and 3,700 feet, an associated levee system width of between 700 feet and 3,900 feet, and levee heights of an average 4 feet to 5 feet, depending on the level of floodplain habitat modifications incorporated. Specific levee alignments and modifications would be determined through a separate, project-specific study that would consider a variety of factors, including, but not limited to, fisheries and other environmental requirements, flood risk reduction, land uses, subsurface conditions, topography, and the condition of existing levees. Because of uncertainty regarding the life history behavior of introduced salmon, modifications to Reach 2B may or may not emphasize floodplain habitat for rearing juvenile Chinook salmon, and any modifications would be determined from results of subsequent site-specific studies.

The San Mateo Road, which crosses the river in Reach 2B, may cause backwater effects and downstream scour, and may act as a barrier to upstream salmon migration during low

flows. Subsequent, project-specific technical studies of this crossing would identify the type of modifications that would be necessary for flow and fish passage.

Depending on the final, constructed channel capacity of Reach 2B above the new Mendota Pool Bypass Bifurcation Structure, simultaneous release of 4,500 cfs Restoration Flows to the Mendota Pool Bypass and delivery of San Joaquin River flows to the Mendota Pool may not be possible. Similarly, because Reach 3 is anticipated to have a long-term capacity of 4,500 cfs, simultaneous release of 4,500 cfs of Restoration Flows to the Mendota Pool Bypass and conveyance of flood flows from the James Bypass would not be possible. The Secretary would prioritize flood control and water right delivery obligations over meeting flow targets for Restoration Flows, reducing Restoration Flows in these reaches if channel capacity is insufficient to meet conveyance of flood control or water delivery obligations in combination with Restoration Flows.

Modify Reach 4B1 to Convey at Least 475 cfs. Paragraph 11(a)(3) of the Settlement stipulates required channel modifications in Reach 4B to convey at least 475 cfs. The Act (Section 10009(f)(2)(B)) requires that a determination be made on increasing the channel capacity to 4,500 cfs before undertaking any "substantial construction" in Reach 4B1. Therefore, modifications in Reach 4B1 to convey at least 475 cfs would not include substantial construction, such as changes to existing levees in Reach 4B1. Based on preliminary studies, these modifications are anticipated to include removing in-channel vegetation and modifying road crossings within Reach 4B1. Modifying Reach 4B1 could also include modifications to establish a low-flow channel to support fish migration, ranging from a single low-flow channel to a series of terraced channels to convey incremental low flows of up to 475 cfs or more.

Five road crossings are present in Reach 4B1 that could require modification. These include crossings at Washington Road, Turner Island Road, and three unnamed crossings. It is not known if modifications would be required at the Washington Road or Turner Island Road crossings to allow conveyance of at least 475 cfs or to provide fish passage. Currently, all three unnamed crossings are configured with culverts that may be insufficient to convey 475 cfs and/or may present barriers to upstream migrating adult salmon. Modifying Reach 4B1 could include modifying these road crossings to provide flow capacity and fish passage, as necessary. These modifications could include installing culverts, restructuring the channel, and/or constructing clear span bridges. Project-specific technical studies of these crossings would identify the type of modifications that would be necessary for flow and fish passage, and such modifications would be evaluated in subsequent environmental documents, as needed.

Modify San Joaquin River Headgate Structure to Enable Fish Passage and Flow Routing. Paragraph 11(a)(4) stipulates modifications to the San Joaquin River Headgate Structure to enable fish passage and flow routing of between 500 and 4,500 cfs into Reach 4B1. The Settlement stipulates that these modifications are to be made consistent with the decision on whether to route 4,500 cfs through Reach 4B1. Under all action alternatives, these modifications would be made sufficient to convey at least 475 cfs into Reach 4B1. Modifications to this structure are closely related to Restoration actions in Reach 4B1, described previously.

Modify Sand Slough Control Structure to Enable Fish Passage. The Sand Slough Control Structure could present a barrier to upstream migration of adult salmon. Modifications to the Sand Slough Control Structure for fish passage are stipulated in Paragraph 11(a)(5) of the Settlement. Modifying the Sand Slough Control Structure could include modifying the structure for fish passage pursuant to Paragraph 11(a)(5) of the Settlement by removing the existing flume and replacing it with a gated structure. These modifications would be designed to not adversely affect flood conveyance capacity or functionality of the existing structure. Modifications to this structure are closely related to Restoration actions in Reach 4B1, described in a following section.

Screen Arroyo Canal and Provide Fish Passage at Sack Dam. Paragraph 11(a)(6) of the Settlement stipulates required modifications to Arroyo Canal to prevent entrainment of anadromous fish. Paragraph 11(a)(7) of the Settlement stipulates required modifications at Sack Dam for fish passage. Sack Dam currently provides the water surface elevation necessary for diversion at Arroyo Canal.

Diversions to Arroyo Canal range from zero to 800 cfs, and typically do not exceed 600 cfs. This action could include installing a screening device at the entrance to Arroyo Canal. The screen could be designed to operate with flows of up to 4,500 cfs in the river, while conveying flows into Arroyo Canal, to prevent entrainment of juvenile Chinook salmon in the canal. It also could include constructing a fish ladder at Sack Dam to allow flow and fish passage for a range of flows of up to 4,500 cfs.

Modify Eastside and Mariposa Bypasses to Enable Fish Passage. Paragraph 11(a)(8) of the Settlement stipulates modifications to structures in the Eastside and Mariposa bypass channels to provide anadromous fish passage on an interim basis until completion of Phase 2 actions described below. Paragraph 11(a)(9) of the Settlement stipulates modifications to the Eastside and Mariposa bypass channels to establish a suitable low-flow channel if the Secretary, in consultation with the RA, determines that such modifications are necessary to support anadromous fish migration through these channels. Because the function of the structures and the channel in these bypasses are related, modifications are described together in this section. Potential actions include the following:

- **Modify structures in Eastside and Mariposa bypasses to provide fish passage –** The Mariposa Bypass Bifurcation Structure at the head of the Mariposa Bypass would be modified to allow fish passage for a range of flows of up to 4,500 cfs. The Mariposa Bypass Drop Structure, at the downstream end of the Mariposa Bypass, presents a barrier to fish passage. Modifying the Mariposa Bypass Drop Structure could include constructing a fish ladder to allow upstream and downstream fish passage for a range of flows of up to 4,500 cfs. Modifications would allow the structure to handle 8,500 cfs while not increasing upstream water levels from existing conditions.

- **Modify Eastside and Mariposa bypasses to provide fish passage under low flows –** The Eastside and Mariposa bypass channels were constructed with flat channel bottoms. Although scouring flows since construction have incised low-

flow channels in some areas of the bypasses, some areas may not be passable by fish during low flows. The range of potential actions to provide fish passage under low flows could include no modifications, modifications to develop a single low-flow channel to convey at least 475 cfs, and a series of terraced channels to convey incremental low flows of up to 475 cfs.

Enable Deployment of Seasonal Barriers at Mud and Salt Sloughs. Potential false migration pathways to migrating adult salmon may be present in Mud and Salt sloughs, tributaries to Reach 5. Modifications to Mud and Salt sloughs would be made to enable the deployment of barriers on these sloughs to prevent adult salmon from entering these potentially false migration pathways, consistent with Paragraph 11(a)(10) of the settlement.

Modify Chowchilla Bypass Bifurcation Structure. Paragraph 11(b)(2) of the Settlement stipulates modifications to the Chowchilla Bypass Bifurcation Structure to provide fish passage and prevent fish entrainment, if such modifications are necessary to achieve the Restoration Goal, as determined by the Secretary in consultation with the RA, and with the concurrence of NMFS and USFWS. Gaps between the gates of the Chowchilla Bypass Bifurcation Structure allow some flow to leak through the gates, when closed. The gaps may be large enough to allow fish to pass through into the bypass, leaving them stranded. To address potential stranding of fish in the Chowchilla Bypass, modifying the Chowchilla Bypass Bifurcation Structure could include a range of potential actions, such as no modifications, monitoring and management of fish stranding under flood conditions, ranges of flows for screening the Chowchilla Bypass to prevent fish from entering the bypass, retrofitting the gates to prevent fish from passing through gaps between the closed gates, and/or adding an additional, screened gate to the structure. Modifications to this structure would be designed to not adversely affect the flood conveyance capacity or functionality of the existing structure.

Fill or Isolate Gravel Pits. Paragraph 11(b)(3) of the Settlement stipulates filling and/or isolating the highest priority gravel pits in Reach 1, based on their relative potential for reducing juvenile salmon mortality, as determined by the Secretary in consultation with the RA. Gravel pits could contribute to juvenile salmon mortality through effects on water temperatures and by providing habitat for predator species such as largemouth bass. A project-specific technical study would be necessary to identify the highest priority pits; therefore, this action has a potential range of actions, including no modifications, filling or isolating some or all pits, and regrading the floodplain to fill pits. Modifications to gravel pits could be implemented in connection with other potential Restoration actions described later in this chapter.

Salmon Reintroduction. Paragraph 14 of the Settlement addresses reintroducing spring-run and fall-run Chinook salmon between Friant Dam and the confluence of the San Joaquin River with the Merced River by December 31, 2012. Paragraph 14 states that, “in the event that competition, inadequate spatial or temporal segregation, or other factors beyond the control of the Settling Parties make restoring spring-run and fall-run Chinook salmon infeasible, then priority shall be given to restoring self-sustaining populations of wild spring run Chinook salmon.” The Secretary, through USFWS, and in

consultation with the Secretary of Commerce, DFG, and the RA, will reintroduce spring- and fall-run Chinook salmon "at the earliest practical date after commencement of sufficient flows and the issuance of necessary permits." To help facilitate reintroduction of salmon, a management plan has been developed to help guide implementation of Restoration actions. The range of potential actions for salmon reintroduction spans from reintroducing only spring-run Chinook salmon to reintroducing both fall-run and spring-run Chinook salmon, and could include one or more life stages. Broodstocks would be identified through subsequent studies, and because of the uncertainty associated with broodstock life history, behavioral, and adaptive traits of potential broodstock in the Central Valley, it is most likely that broodstocks would be acquired from a variety of watersheds.

The range of potential actions for salmon reintroduction could also include the use of the existing San Joaquin Hatchery, another existing hatchery, or a new hatchery. Although the design and capacity of a new hatchery would be determined in part by management plans, a new hatchery could potentially provide for initial reintroduction of spring-run Chinook salmon, fall-run Chinook salmon, and/or other native fish. Hatchery use would be phased out over time as the fish population is reestablished. The Restoration Goal and Paragraph 14 of the Settlement emphasize the need to restore self-sustaining fish populations. Therefore, hatchery populations alone would not fulfill the Restoration Goal, and naturally reproduced individuals would need to be distinguished from hatchery-produced individuals.

This Draft PEIS/R identifies potential system effects associated with reintroducing salmon. USFWS submitted a 10(a)(1)(a) Enhancement of Species Permit application to NMFS on September 30, 2010, for introducing an experimental population of spring-run Chinook salmon, consistent with the schedule identified in the Settlement. NMFS will issue a final rule pursuant to Section 10(j) of the Federal Endangered Species Act of 1973 (ESA), as amended, by April 30, 2012. Specific environmental effects related to the reintroduction of spring-run Chinook salmon would be addressed in the subsequent project-specific NEPA analysis, and possibly CEQA analysis, in compliance with an associated Special Rule authorizing the experimental population.

Enhance Spawning Gravel. Adult Chinook salmon require suitable gravels, refuge, water depths, and velocities for spawning. The range of potential actions to provide for adequate spawning gravel could include no modifications, augmenting and/or conditioning gravel at existing riffles, or establishing new riffles, as described below:

- **No modifications –** No actions would be taken to modify, augment, or condition gravel either at existing riffles or through establishing new riffles.

- **Augment existing riffles –** This action consists of augmenting existing riffles with clean, spawning-sized gravel at some, or a portion of, the existing spawning areas in Reach 1.

- **Establish new riffles –** This action consists of establishing new riffles to increase and enhance salmonid spawning habitat in Reach 1.

Reduce Potential for Redd Superimposition and/or Hybridization. Spring-run Chinook salmon typically spawn earlier than fall-run Chinook salmon, creating the potential for redd superimposition, when fall-run Chinook salmon construct their redds on top of spring-run redds and dislodge or smother some of the spring-run eggs. In addition, a small percentage of fall-run Chinook salmon may spawn at the same time and location as spring-run Chinook salmon; therefore, potential may exist for hybridization. Hybridization may result in fish with migratory behaviors that are not viable in the San Joaquin River basin. The range of potential actions to reduce redd superimposition or hybridization includes no modifications, the deployment of seasonal barriers, and separate runs of salmon, and also could include potential operation and monitoring of the Hills Ferry Barrier on a seasonal basis.

The ability to control run timing via additional structures to separate spring- and fall-run Chinook salmon, as well as the ability to manage flows to prevent run overlap and hybridization, is unknown. The location and design of barriers has yet to be determined; evaluation of spawning habitat availability and quality would likely guide this decision.

Supplement Salmon Population. Additional actions not identified in the Settlement could be necessary to supplement the naturally reproducing population, particularly in the years immediately following salmon reintroduction. The Settlement does not stipulate any actions to supplement the salmon population; therefore, a subsequent decision would be required before any such actions could be implemented. The range of potential actions to supplement the salmon population could include no supplementation, the release of hatchery fish to supplement the natural population for monitoring and management of the natural population, and/or release of hatchery fish to supplement the natural population when natural production is low. These actions are described in greater detail below. Subsequent studies would identify stock for hatchery populations and, as described for salmon reintroduction according to Paragraph 14 of the Settlement, stock for hatchery populations would likely come from a Central Valley population with behavioral and life history characteristics compatible with anticipated conditions on the San Joaquin River. As previously discussed, hatchery populations alone would not fulfill the Restoration Goal, and naturally reproduced individuals would need to be distinguished from hatchery-produced individuals.

- **No supplementation** – No actions would be undertaken to release fish into the San Joaquin River.

- **Release of hatchery salmon to supplement the natural population for monitoring and management** – This action consists of releasing study fish to support evaluations during implementation and monitoring, as needed.

- **Release of hatchery salmon to supplement the natural population for survival –** This action could consist of using hatchery fish to supplement the population in years when monitoring determines that the natural production of juvenile salmon is too low. This could occur during the relatively dry water year types (e.g., Settlement Critical-Low, Critical-High year types) when spring flows are either absent or inadequate to sustain Chinook salmon populations.

Modify Floodplain and Side-Channel Habitat. Additional actions not identified in the Settlement could be necessary to modify the floodplain or side-channel habitat beyond Reaches 2B or 4B1. Such modifications could benefit migrating salmon and other native fishes by providing additional food sources, increased protection from stranding, and other habitat improvements. The range of potential actions to modify floodplain and side-channel habitat outside Reaches 2B and 4B1 could include no modifications; creating and/or enhancing additional floodplain habitat; creating, enhancing, or isolating side channels; and/or reducing sand transport.

- **No modifications** – No modifications would be undertaken to modify the floodplain and side-channel habitat.

- **Create and/or enhance additional floodplain habitat –** This action could consist of creating and/or enhancing additional floodplain habitat outside Reaches 2B and 4B1 (floodplain modifications in these reaches are described previously as actions stipulated by the Settlement) to provide flexibility to accommodate variable life history strategies of future salmon populations, which may vary spatially and temporally. Modifications would be confined within the existing levee alignment. This action also includes floodplain modifications in reaches other than Reach 2B and Reach 4B1 to provide for the maintenance of floodplain vegetation at a level to be determined based on the associated contribution toward achieving the Restoration Goal.

- **Create, enhance, or isolate side channels –** Side channels occur throughout the river, some with perennial connectivity to the main channel, but most with connectivity only under high-flow conditions, as described in Chapter 3.0. In some cases, side channels could provide suitable rearing habitat for juvenile salmon, or serve as holding habitat for adult salmon, while other side channels may foster conditions that are unsuitable for salmon, including high temperatures and habitat for predatory species such as largemouth bass. Side-channel enhancement activities could include dredging or widening side channels. Side-channel isolation could consist of filling a channel or constructing berms across the mouth of a channel. Additionally, new side channels could be created to provide additional habitat, if necessary. Creation of new side channels could likely be accomplished through dredging new channels or removing sediment blocking the connectivity of former channels.

- **Reduce sand transport –** The quantity of sand in Reaches 1 and 2 may present challenges to channel stability, and the function of hydraulic control structures and road crossings. This sand has the potential to be mobilized by Interim and Restoration flows to lower reaches that do not currently have sediment transport issues. This action would control sources of sand in Reach 1, and transport of sand in downstream river and bypass reaches, to prevent hydraulic and facilities challenges arising from channel migration, aggradation, or degradation. Control of sediment at tributary sources could include settling basins, bed stabilization (such as floodplain widening to reduce sediment transport potential) in areas where the bed is degrading, and bank stabilization in meandering reaches. In-

channel sand could be removed by dredging or by constructing instream sediment detention basins, or sand traps, to capture sand. Accumulated sand would need to be removed periodically to maintain the functionality of sand traps. As previously described, portions of Reach 1 may benefit from modifications to gravel quantities and mobility.

Enhance In-Channel Habitat. This action could incorporate channel modifications to provide salmon habitat, including instream cover such as undercut banks, overhanging vegetation, boulders, large wood, surface turbulence, and features providing refuge from predation. The range of potential actions to enhance in-channel habitat could include no modifications, augmenting existing, and/or creating new, in-channel habitat. Enhancing in-channel habitat could also include modifications such as constructing pools, or dredging and grading to develop or maintain more desirable water temperatures. Deep pools remain cooler during warm summer months, and provide refuge from avian and terrestrial predators. Additional assessments would be conducted to identify the potential for groundwater influence on instream temperatures, and whether water temperature requirements may be met under different conditions and/or different timing of flow releases from Friant Dam.

Reduce Potential for Aquatic Predation of Juvenile Salmonids. Additional actions not identified in the Settlement could be necessary to prevent aquatic predation of juvenile salmonids. Additional potential actions to prevent aquatic predation of juvenile salmonids could include capturing and removing nonnative aquatic predatory species.

Reduce Potential for Fish Entrainment. Unscreened and poorly screened small diversions can entrain migrating juvenile fish. The Settlement does not stipulate actions to screen these small diversions. The range of potential actions to prevent fish entrainment at small diversions could include not screening diversions, or installing or modifying screens at small diversions throughout the Restoration Area. The number of screens installed would be determined through future studies, but could be based on the relative impact of individual diversions to fisheries.

Enable Fish Passage. Obstacles to the successful migration of anadromous fish in the Restoration Area could include hydraulic conditions at road crossings; small San Joaquin River tributaries with unsuitable habitat for salmon spawning and rearing; hydraulic conditions in the river channel at low flow; and other physical features within the river. The range of potential actions to enable fish passage beyond the actions stipulated in the Settlement could include no modifications, establishing and/or maintaining low-flow channels, trapping and hauling juveniles and adults, modifying road crossings, and installing barriers to prevent straying.

- **No modifications** – No actions would be undertaken to enable fish passage.

- **Establish and/or maintain low-flow channels** – This action consists of modifying the channel in reaches outside the Eastside and Mariposa bypasses and Reach 4B1 to provide passage during low-flow conditions, as needed. As described above for the action to enhance in-channel habitat through reducing

sand transport, establishing and/or maintaining low-flow channels could include bed stabilization in areas where the bed is degrading, and bank stabilization in meandering reaches. Removing in-channel sand to maintain a low-flow channel could be accomplished by dredging or grading. The range of actions described above for modifications to floodplain and side-channel habitat, such as managing invasive vegetation and creating and/or enhancing additional floodplain habitat, could also be applied to establish and/or maintain low-flow channels through bed and bank stabilization.

- **Trap and haul –** It may be necessary to implement a trap-and-haul operation to sustain Chinook salmon within the Restoration Area if protective features are not completed in time to reintroduce fish, if it is determined that entrainment and physical barriers exist that could hinder reintroducing and managing fish populations, or if river connectivity is disrupted (i.e., in critical water years). Implementing a trap-and-haul program could consist of trapping salmon smolts in upper reaches (likely Reach 1 or Reach 2) to transport smolts to downstream reaches for release, thereby avoiding temporary undesirable habitat conditions (such as high temperatures or discontinuous flow). In addition, implementing a trap-and-haul program could include trapping adult salmon in downstream reaches and transporting them to Reach 1, thereby avoiding temporary undesirable habitat conditions in intermediate reaches. Several trapping mechanisms could be applied under this action, including passive and active capture techniques. Trapped fish could be transported under controlled conditions by truck to suitable habitat areas and released. Trap-and-haul operations are not envisioned as a long-term management strategy, and would only be used as temporary measure if protective features are not completed in time to reintroduce fish, if it is determined that entrainment and physical barriers exist that could hinder reintroducing and managing fish populations, or if river connectivity is disrupted.

- **Modify road crossings –** This action consists of modifying road crossings to provide for fish passage in Reach 1. These crossings could be modified through installing culverts, restructuring the channel, and/or constructing clear span bridges to enable the crossings to be used during Restoration Flows while providing fish passage. Road crossings in Reaches 2B and 4B that pose potential barriers to fish passage are discussed as possible actions to address Settlement Paragraphs 11(a)(2) and 11(a)(3), respectively.

- **Install barriers to prevent straying –** This action could consist of installing temporary or permanent barriers in the channel to prevent fish from straying into tributaries, flood bypasses, or river reaches with undesirable habitat conditions. The primary categories of permanent fish barrier structures are picket barriers, velocity barriers, and vertical drop structures. Tributaries, flood bypasses, and river reaches that could be screened under this action depend in part on the flow-routing decision made consistent with Paragraph 11(b)(1) of the Settlement, but could include, but may not be limited to, Dry and Cottonwood creeks in Reach 1; Deadmans, Bear, and Owens creeks in the Eastside Bypass; the

downstream end of Eastside Bypass Reach 2; the downstream end of Reach 4B; and the downstream end of Eastside Bypass Reach 3.

Modify Flood Flow Control Structures. Additional actions not identified in the Settlement could be necessary to improve fish passage and flow conveyance at flood control structures within the Restoration Area, including modifications to the Chowchilla Bypass Bifurcation Structure, Sand Slough Control Structure, and structures in the Eastside and Mariposa bypasses. The range of potential additional actions to modify flood control structures could include no modifications, retrofitting gates at flood control structures to prevent flow loss, and installing grade control structures to address backwater effects of the Chowchilla Bypass Bifurcation Structure.

- **No modifications** – No actions would be undertaken to modify flood flow control structures.

- **Retrofit gates –** As described for the range of actions to address Paragraph 11(b)(2) of the Settlement, gaps between the gates of the Chowchilla Bypass Bifurcation Structure allow some flow to leak through the gates, when closed. Because of the current function of the structure in routing relatively large flows under flood conditions, the small amount of water lost through closed gates at this and other gated flood control structures in the system (including the San Joaquin River Headgates, Eastside Bypass Bifurcation Structure, and Mariposa Bypass Bifurcation Structure) is not a concern under current operations. However, during the release of Interim and Restoration flows, the loss of water from the main stem San Joaquin River through the closed gates to the bypass channel could inhibit success of the Restoration Goal by reducing the amount of water flowing to downstream reaches. Potential actions to address flow loss range from no retrofit implementation to retrofitting the gates on the existing flood control structures to prevent flow from passing the closed gates.

- **Install grade control structures –** Local backwater effects caused by the Chowchilla Bypass Bifurcation Structure may be contributing to the accumulation of sand in Reach 2A (McBain and Trush 2002), which could mobilize under Interim or Restoration flows, thereby compromising the ability to convey Interim or Restoration flows through downstream reaches. The Settlement does not stipulate any actions to modify the Chowchilla Bypass Bifurcation Structure to address flow loss or sediment deposition due to backwater effects; therefore, a subsequent decision would be required before any such actions could be implemented. Potential actions to address sediment deposition upstream from the Chowchilla Bypass Bifurcation Structure range from no implementation to installing grade control structures to prevent sediment mobilization.

4.2.3 Physical Monitoring and Management Plan

The Physical Monitoring and Management Plan is included in this Draft PEIS/R as Appendix D, and is summarized here. The Physical Monitoring and Management Plan provides guidelines for observing and adjusting to changes in physical conditions within the Restoration Area. The Physical Monitoring and Management Plan consists of five

component plans, addressing interrelated physical conditions including flow, groundwater seepage, channel capacity, propagation of native vegetation, and suitability of spawning gravel. Each component plan identifies objectives for the physical conditions within the Restoration Area, and provides guidelines for the monitoring and management of those conditions. The plans identify potential actions that could be taken to further enhance the achievement of the objectives. The component plans include immediate actions that could be taken, which are analyzed at a project level in this Draft PEIS/R. The component plans also include long-term actions that are analyzed at a program level of detail in this Draft PEIS/R. Finally, this Plan includes a description of monitoring activities which apply to one or more of the component plans. The five component plans include the following:

- **Flow** – To ensure compliance with the hydrograph releases in Exhibit B of the Settlement and any other applicable flow releases (e.g., Buffer Flows)
- **Seepage** – Reduce or avoid adverse or undesirable seepage impacts
- **Channel capacity** – Maintain flood conveyance capacity
- **Native vegetation** – Establish and maintain native riparian habitat
- **Spawning gravel** – Maintain gravels for spawning

The Physical Monitoring and Management Plan includes monitoring activities and a set of immediate (project level) responses that would be implemented, as needed, to attain the management objectives. The plan also identifies potential long-term (program level) responses that could be implemented to attain the management objectives, if necessary. Monitoring activities and responses are described below. Monitoring and management guidelines related to biological conditions for fish are separately described in Appendix F, "Fisheries Management Plan."

Monitoring Activities

Monitoring activities include past, present, and future physical and nonphysical activities within the Restoration Area. Site-specific documentation has been completed for those actions completed or currently underway, and would be completed as necessary for those actions described at a program level of detail in this Draft PEIS/R. Monitoring activities, as described in the Physical Monitoring and Management Plan, are guidelines for monitoring and could change as part of implementation of the Settlement. These activities include the following:

- **Flow monitoring** – Flow, cross sections, and surface water stage at six gaging stations, and at additional locations during high-flow events
- **Groundwater level monitoring** – Groundwater elevation in monitoring wells
- **Aerial and topographic surveys** – True color aerial photographs and topographic surveys to assess river stage, hydraulic roughness, river width, bed elevation, and vegetation conditions

- **Vegetation surveys** – Surveys of seed dispersal start and peak times, and native riparian vegetation establishment

- **Sediment mobilization monitoring** – Sediment mobilization, bar formation, and bank erosion through aerial and topographic surveys of areas with elevated erosion potential

- **Spawning gravel monitoring** – Pebble count or photographic surveys of riffles following Normal-Wet or Wet years

Immediate Management Actions – Project Level

Potential immediate responses have been identified to contribute to attaining the seepage, channel capacity, and spawning gravel management objectives. No immediate responses have been identified to contribute to attaining the flow or vegetation management objectives. Potential immediate responses to attain the groundwater seepage, channel capacity, and spawning gravel management objectives include the following:

- **Seepage –** Reduce, redirect, or redivert Interim or Restoration flows to reduce flow in downstream reaches. This could include the following:

  - **Reductions of Interim or Restoration Flow Releases at Friant Dam** – Reductions in the release rate from Friant Dam to limit the potential for seepage impacts to occur downstream. Planned thresholds for reductions at Friant would need to consider travel time and associated response delays.

  - **Redirection of Interim or Restoration Flows at Chowchilla Bypass Bifurcation Structure** – Directing flow into the bypass system at the Chowchilla Bypass Bifurcation Structure would reduce flow in Reach 2B and downstream reaches.

  - **Delivery of Interim or Restoration Flows at Mendota Pool** – Delivery of water to Mendota Pool would reduce flows in Reach 3 and downstream reaches.

  - **Delivery of Interim or** Restoration **Flows at Arroyo Canal** – When San Luis Canal Company is not diverting at the full capacity of Arroyo Canal, additional water diversions to the canal would reduce flows in Reach 4A and downstream reaches.

  - **Redirection of Interim or Restoration Flows at Sand Slough Control Structure** – During the first year of Interim Flows, water would not be directed into Reach 4B. In subsequent years, diverting flows into the bypass system at Sand Slough Control Structure would reduce flows in Reach 4B.

- **Channel capacity** – Removal of vegetation and debris that would cause Interim or Restoration flows to exceed channel capacity. Vegetation would be removed by mechanical or chemical means. Nonnative plant removal would receive priority over removal of native species.

- **Spawning gravel –** Modify releases from Friant Dam to adjust flows to flush or mobilize based on monitoring reports and recommendations of spawning gravel conditions (including potential modifications to Restoration Flow Guidelines to improve the success of Flushing Flows).

Long-Term Management Actions – Program Level

Potential long-term responses have been identified to contribute to attaining the flow, groundwater seepage, channel capacity, native vegetation, and spawning gravel management objectives. Potential long-term responses to attain the management objectives may require additional environmental documentation, and include the following:

- **Flow** – Paragraph 13(c) of the Settlement provides for adjusting releases due to unexpected seepage losses. These actions could include but would not be limited to acquisition and release of purchased water from willing sellers. The procedures for purchasing and releasing additional water are under development and would be detailed in the Restoration Flow Guidelines, a document that would be attached to the Friant Operation Guidelines.

- **Seepage –** Long-term management actions for seepage may include, but would not be limited to, purchasing easements and/or compensation for seepage effects, construction of slurry walls to reduce seepage flows, construction of seepage berms to protect against levee failure, construction of drainage interceptor ditches to protect affected lands, or installation of tile drains on affected lands.

- **Channel capacity –** Long-term management actions for channel capacity may include, but would not be limited to, providing a larger floodplain between levees through the acquisition of land and construction of setback levees, regrading of land between levees, construction of sediment traps, construction of grade control structures, or channel grading.

- **Native vegetation –** Long-term management actions for native vegetation may include, but would not be limited to, active plantings and irrigation of desired native plants.

- **Spawning gravel –** Long-term management actions for spawning gravel may include, but would not be limited to gravel augmentation and/or conditioning at existing riffles, establishment of new riffles, engineered channel modifications, construction of sediment traps on the San Joaquin River or tributaries with high sediment loads, or construction of grade control structures.

4.2.4 Conservation Strategy

As part of Settlement implementation, a comprehensive strategy for the conservation of listed and sensitive species and habitats has been prepared, and would be implemented in coordination with USFWS, NMFS, and DFG. The strategy's purpose is to serve as a tool built into the project description to minimize and avoid potential impacts to sensitive species and habitats. This Conservation Strategy guides development and implementation of specific conservation measures for project- and program-level actions. The Conservation Strategy includes conservation goals and measures for species and communities (such as avoidance, minimization, monitoring, and management measures) consistent with adopted recovery plans, as described below. If avoidance and minimization measures are impractical or infeasible, then further consultation actions and mitigation measures will be pursued and developed in coordination with the appropriate regulatory agency.

To achieve the Restoration Goal, a number of actions that are proposed to be implemented may substantially alter not only the aquatic ecosystem of the San Joaquin River, but also the river's riparian and wetland ecosystems, and some adjacent upland ecosystems. Riparian, wetland, and upland ecosystems of the Central Valley, such as those along the San Joaquin River, provide habitat for a large number of species, including several Federally listed and State-listed species. Therefore, the action alternatives include this Conservation Strategy, which would be implemented in a manner that is consistent with adopted conservation plans for sensitive species, and for wetland and riparian ecosystems of the Restoration Area.

The Conservation Strategy consists of management actions that would result in a net benefit for riparian and wetland habitats in the Restoration Area, to avoid reducing the long-term viability of sensitive species, and to be consistent with adopted conservation plans. The goals of the strategy are described below:

- **Conserve riparian vegetation and waters of the United States, including wetlands** – It is anticipated that implementing the Settlement would result in a net increase in the acreage of riparian and wetland vegetation in the Restoration Area. However, several program actions may disturb or eliminate riparian vegetation or waters of the United States (including wetlands). If impacts to waters of the United States (including wetlands), navigable waters, or the Federal levee system cannot be avoided, a USACE Section 404, Section 408, and/or Section 10 permit and Central Valley Regional Water Quality Control Board (RWQCB) Section 401 water quality certification would be obtained. Increased acreage of wetlands resulting from Interim and Restoration flows may be considered a means of replacing, restoring, or enhancing wetlands. However, the acreage, location, and methods of replacing, restoring, or enhancing wetlands would be determined during these permitting processes.

- **Control and manage invasive species** – Because of their adverse effects on aquatic and riparian ecosystems, the spread of invasive plant species as a result of release of Interim and Restoration flows would be controlled and managed. For each invasive plant species with known infestations, thresholds for management

responses and specific management responses would be established and implemented (including species-specific control methods).

- **Conserve special-status species** – Populations of special-status species would benefit from restoring and sustaining riparian and wetland habitat, and controlling invasive species, as described previously. However, during the initiation of Interim and Restoration flows, and the construction of related actions, a variety of special-status species of upland, wetland, and riparian habitats could experience adverse effects. Therefore, this strategy includes measures to prevent or reduce impacts that could result from loss of habitat within project footprints or from impacts on adjacent habitat or species. In addition, this strategy includes coordination with appropriate regulatory agencies to provide mitigation or compensation, consistent with applicable conservation plans, to avoid or minimize effects when actions would result in a net loss of habitat or other substantial adverse effects, if the implementation of avoidance and minimization measures is infeasible or impractical.

These measures address all potentially affected Federally listed and/or State-listed species, and all other species identified by USFWS, NMFS, or DFG as candidates, sensitive, or special-status in local or regional plans, policies, or regulations. For individual project- and program-level actions under each of the action alternatives, the applicable, feasible measures would guide development of action-specific conservation strategies. Table 4-5 presents the Conservation Strategy.

Table 4-5.
Conservation Measures for Biological Resources That May Be Affected by Settlement Actions

Conservation Measure and Identifier	Applicable Habitat and/or Species, and Conservation Measure Description	Level of Compliance	Regulatory Agency
VP	**Vernal pool habitats, fleshy (succulent) owl's clover, Hoover's spurge, Bogg's Lake hedge-hyssop, Colusa grass, San Joaquin Valley Orcutt grass, hairy Orcutt grass, Conservancy fairy shrimp, longhorn fairy shrimp, vernal pool fairy shrimp, vernal pool tadpole shrimp, and western spadefoot toad**		
VP-1. Avoid effects to species	a) If vernal pools or vernal pool species are anticipated within a project area, a qualified biologist will identify and map vernal pool and seasonal wetland habitat potentially suitable for listed vernal pool plants, invertebrates, and western spadefoot toad within the project footprint. b) Facility construction and other ground-disturbing activities will be sited to avoid core areas identified in the *Vernal Pool Recovery Plan* (USFWS 2005) because conservation of these areas is a high priority for recovering listed vernal pool species.	Project and Program	USFWS DFG
VP-2. Minimize effects to species	a) If vernal pools are present, a buffer around the microwatershed or a 250-foot-wide buffer, whichever is greater, will be established before ground-disturbing activities around the perimeter of vernal pools and seasonal wetlands that provide suitable habitat for vernal pool crustaceans or vernal pool plants. This buffer will remain until ground-disturbing activities in that area are completed. Suitable habitat and buffer areas will be clearly identified in the field by staking, flagging, or fencing. b) Appropriate fencing will be placed and maintained around all preserved vernal pool habitat buffers during ground-disturbing activities to prevent impacts from vehicles and other construction equipment. c) Worker awareness training and on-site biological monitoring will occur during ground-disturbing activities to ensure buffer areas are being maintained.	Program	Lead Agency

Table 4-5.
Conservation Measures for Biological Resources That May Be Affected by Settlement Actions (contd.)

Conservation Measure and Identifier	Applicable Habitat and/or Species, and Conservation Measure Description	Level of Compliance	Regulatory Agency
VP-3. Compensate for temporary or permanent loss of habitat	a) If activities occur within the microwatershed or 250-foot-wide buffer for vernal pool habitat will be affected by the SJRRP, the project proponent will develop and implement a compensatory mitigation plan, consistent with the USACE and EPA April 10, 2008, Final Rule for Compensatory Mitigation for Losses of Aquatic Resources (33 CFR Parts 325 and 332 and 40 CFR Part 230) and other applicable regulations and rules at the time of implementation, that will result in no net loss of acreage, function, and value of affected vernal pool habitat. Unavoidable effects will be compensated through a combination of creation, preservation, and restoration of vernal pool habitat or purchase of credits at a mitigation bank approved by the applicable regulatory agency/agencies. b) Project effects and compensation will be determined in consideration of the *Vernal Pool Recovery Plan* goals for core areas, which call for 95 percent preservation for habitat in the Grasslands Ecological Area and Madera core areas, and 85 percent habitat preservation in the Fresno core area (USFWS 2005). c) Appropriate compensatory ratios for loss of habitat both in and out of core areas will be determined during coordination and consultation with USFWS and/or DFG, as appropriate. d) If off-site compensation includes dedication of conservation easements, purchase of mitigation credits, or other off-site conservation measures, the details of these measures will be and developed as part of the USFWS and/or DFG coordination and consultation process. The plan will include information on responsible parties for long-term management, holders of conservation easements, long-term management requirements, and other details, as appropriate, for the preservation of long-term viable populations. Any impacts that result in a compensation purchase will require an endowment for land management in perpetuity before any project groundbreaking activities.	Project and Program	USFWS DFG

Table 4-5.
Conservation Measures for Biological Resources That May Be Affected by Settlement Actions (contd.)

Conservation Measure and Identifier	Applicable Habitat and/or Species, and Conservation Measure Description	Level of Compliance	Regulatory Agency
CH	**Critical habitat**		
CH-1. Avoid and minimize effects to critical habitat	a) Designated critical habitats shall be identified and mapped. b) All SJRRP actions will be designed to avoid direct and indirect adverse modifications to these areas. c) Minimization measures, such as establishing and maintaining buffers around areas of designated critical habitat, shall be implemented if avoidance is not feasible.	Project and Program	USFWS
CH-2. Compensate for unavoidable adverse effects on Federally designated critical habitat	a) If critical habitat may be adversely modified by the implementation of SJRRP actions, the area to be modified will be evaluated by a qualified biologist to determine the potential magnitude of the project effects (i.e., description of primary constituent elements present and quantification of those affected) at a level of detail necessary to satisfy applicable environmental compliance and permitting requirements. b) Compensatory conservation measures developed through Section 7 consultation with USFWS will be implemented. If off-site compensation includes dedication of conservation easements, purchase of mitigation credits, or other off-site conservation measures, the details of these measures will be included in and developed as part of the USFWS consultation process. The plan will include information on responsible parties for long-term management, holders of conservation easements, long-term management requirements, and other details, as appropriate, for the preservation of long-term viable populations. Any impacts that result in a compensation purchase require an endowment for land management in perpetuity before any project groundbreaking activities.	Project and Program	USFWS
CTS	**California tiger salamander**		
CTS-1. Avoid and minimize effects to species	a) If potential California tiger salamander habitat or species are anticipated within the project area, within 1 year before project construction activities, a qualified biologist shall identify and map potential California tiger salamander habitat (areas within 1.3 miles of known or potential California tiger salamander breeding habitat) within the project footprint. One week before ground-disturbing activities, a qualified biologist will survey for and flag the presence of ground squirrel and gopher burrow complexes. Where burrow complexes are present, a 250-foot-wide buffer shall be placed to avoid and minimize disturbance to the species. b) Facility construction and other ground-disturbing activities shall be sited to avoid areas of known California tiger salamander habitat and avoidance buffers. c) To eliminate an attraction to predators of the California tiger salamander, all food-related trash items such as wrappers, cans, bottles, and food scraps, must be disposed of in closed containers and removed at least once every day from the entire project site.	Program	USFWS DFG

Table 4-5.
Conservation Measures for Biological Resources That May Be Affected by Settlement Actions (contd.)

Conservation Measure and Identifier	Applicable Habitat and/or Species, and Conservation Measure Description	Level of Compliance	Regulatory Agency
CTS-2. Minimize effects to species	a) Before and during construction activities, construction exclusion fencing will be installed just outside the work limit or around vernal pools where California tiger salamander may occur. This fencing shall be maintained throughout construction and will be removed at the conclusion of ground-disturbing activities. No vehicles will be allowed beyond the exclusion fencing. A USFWS-approved biological monitor shall be present on site, during intervals recommended by USFWS, to inspect the fencing. b) The biological monitor will be on site each day during any wetland restoration or construction, and during initial site grading or development of sites where California tiger salamanders have been found. c) Before the start of work each day, the biological monitor will check for animals under any equipment to be used that day, such as vehicles or stockpiles of items such as pipes. If California tiger salamanders are present, they will be allowed to leave on their own, before the initiation of construction activities for the day. To prevent inadvertent entrapment of California tiger salamanders during construction, all excavated, steep-walled holes or trenches more than 1 foot deep shall be covered, by plywood or similar materials, at the close of each working day or provided with one or more escape ramps constructed of earth fill or wooden planks. Before such holes or trenches are filled, they must be thoroughly inspected for trapped animals. d) Plastic monofilament netting (erosion control matting) or similar material shall not be used at the project site because California tiger salamanders may become entangled or trapped. Acceptable substitutes include coconut coir matting or tackified hydroseeding compounds. e) All ground-disturbing work shall occur during daylight hours. Clearing and grading will be conducted between April 15 and October 15, in coordination with USFWS and DFG, and depending on the level of rainfall and site conditions. f) Revegetation of project areas temporarily disturbed by construction activities will be conducted with locally occurring native plants.	Program	USFWS
CTS-3. Compensate for temporary or permanent loss of habitat	a) If California tiger salamander, or areas within 1.3 miles of known or potential California tiger salamander breeding habitat, would be affected by the SJRRP, the project proponent will develop and implement a compensatory mitigation plan in coordination with USFWS and DFG, as appropriate. Unavoidable effects will be compensated through a combination of creation, preservation, and restoration of habitat or purchase of credits at a mitigation bank approved by the regulatory agencies. b) If off-site compensation includes dedication of conservation easements, purchase of mitigation credits, or other off-site conservation measures, the details of these measures will be included in and developed as part of the USFWS and/or DFG coordination and consultation process. The plan will include information on responsible parties for long-term management, holders of conservation easements, long-term management requirements, and other details, as appropriate, for the preservation of long-term viable populations. Any impacts that result in a compensation purchase will require an endowment for land management in perpetuity before any project groundbreaking activities.	Program	USFWS DFG

Table 4-5.
Conservation Measures for Biological Resources That May Be Affected by Settlement Actions (contd.)

Conservation Measure and Identifier	Applicable Habitat and/or Species, and Conservation Measure Description	Level of Compliance	Regulatory Agency
DBC	**Delta button-celery**		
DBC-1. Avoid and minimize loss of habitat and individuals	a) Historically, Delta button celery was known to exist in the Eastside and Mariposa bypasses (CNDDB). In most areas of the bypasses, local flows up to 1,500 cfs remain in the main channel, and do not inundate the floodplain. Maintaining flows at or below 1,500 will not impact Delta button celery populations. In general, historical Delta button celery populations have been located below the 2,500 cfs inundation area (CNDDB). If these historical populations are still thriving in these areas, flows between 1,500 cfs and 2,500 cfs will most likely impact these populations. Potential areas of impact within the Eastside Bypass from the Sand Slough Bypass to the Mariposa Bypass are approximately 400 acres, and for the Mariposa Bypass, approximately 100 acres. Before increasing flows above 1,500 cfs in these specific areas, comprehensive surveys will be conducted. Surveys will include remapping and recensus of the documented occurrences during at least 2 consecutive or nonconsecutive years when habitat conditions are favorable to detect the species to determine the population trend. Status updates for these occurrences will be provided to DFG. b) A Delta button-celery conservation plan will be developed and implemented that includes a preservation and adaptive management strategy for existing occurrences within the Restoration Area. The conservation plan will be developed in collaboration with DFG and other species experts, and be supported by review of the existing literature, including information on species' life history characteristics, historic and current distribution, and microhabitat requirements.	Project and Program	DFG
DBC-2. Avoid and minimize loss of habitat and risk of take for implementation of construction activities	a) If direct impacts to Delta button celery could occur, DFG and the appropriate State lead agency will coordinate to determine specific minimization and mitigation measures	Program	Lead Agency

Table 4-5.
Conservation Measures for Biological Resources That May Be Affected by Settlement Actions (contd.)

Conservation Measure and Identifier	Applicable Habitat and/or Species, and Conservation Measure Description	Level of Compliance	Regulatory Agency
DBC-3. Compensate for temporary or permanent loss of habitat	a) Compensatory mitigation for Delta button-celery will be developed in consultation with DFG. Mitigation may include the development and implementation of habitat creation and enhancement designs to incorporate habitat features for Delta button-celery (e.g., depressions within seasonally inundated areas) into floodplains with potentially suitable habitat conditions. Compensatory mitigation may also include efforts to establish additional populations in the Restoration Area or to enhance existing populations on or off site. Mitigation sites will avoid areas where future SJRRP activities are likely. The project proponent will obtain site access through a conservation easement or in-lieu fee title and will provide adequate funding to implement the required compensation measures, and to monitor compliance with and success of the conservation measures. b) Establishment of new occurrences will be attempted by transplanting seed and plants from affected locations to created habitat or suitable, but unoccupied, existing habitat. c) Monitoring, performance criteria, and protective measures will be applied to compensatory mitigation sites. The replacement requirements, and any additional conservation and mitigation measures will be determined in coordination with DFG.	Project and Program	DFG

Table 4-5.
Conservation Measures for Biological Resources That May Be Affected by Settlement Actions (contd.)

Conservation Measure and Identifier	Applicable Habitat and/or Species, and Conservation Measure Description	Level of Compliance	Regulatory Agency
PALM	**Palmate-bracted bird's beak**		
PALM-1. Avoid and minimize effects to species	a) If palmate-bracted bird's beak is anticipated within the project area, a qualified botanist will identify and map the location of palmate-bracted bird's beak plants within the project footprint, within 1 year before the start of activities that may cause disturbance from either release of flows over 1,660 cfs or from ground-disturbing actions. b) A minimum 500-foot-wide buffer shall be placed around occurrences of palmate-bracted bird's beak during construction activities, consistent with recommendations in the *Recovery Plan for Upland Species of the San Joaquin Valley, California* (USFWS 1998). The 500-foot-wide buffer will be clearly identified in the field by staking, flagging, or fencing. Project activity will avoid buffer areas, and work awareness training and biological monitoring will be conducted to ensure that the buffer area is not encroached on and that effects are being avoided.	Project and Program	USFWS DFG
PALM-2. Compensate for temporary or permanent loss of occupied habitat	a) A compensatory conservation plan shall be developed in coordination with USFWS and DFG, as appropriate. The conservation plan will require the project proponent to maintain viable plant populations in the Restoration Area and will identify compensatory measures for any populations affected. The conservation plan shall include monitoring and reporting requirements for populations to be preserved in or adjacent to construction areas, or populations to be protected or enhanced off site. b) If relocation efforts are part of the conservation plan, the plan will include details on the methods to be used: collection, relocation/transplant potential, storage, propagation, preparation of receptor site, installation, long-term protection and management, monitoring and reporting requirements, and remedial action responsibilities should the initial effort fail to meet compensation requirements. c) If off-site compensation includes dedication of conservation easements, purchase of mitigation credits, or other off-site conservation measures, the details of these measures will be included in the conservation plan and must occur with full endowment for management in perpetuity before groundbreaking. The plan will include information on responsible parties for long-term management, holders of conservation easements, long-term management requirements, and other details, as appropriate, for the preservation of long-term viable populations.	Project and Program	USFWS DFG

Table 4-5.
Conservation Measures for Biological Resources That May Be Affected by Settlement Actions (contd.)

Conservation Measure and Identifier	Applicable Habitat and/or Species, and Conservation Measure Description	Level of Compliance	Regulatory Agency
VELB	**Valley elderberry longhorn beetle**		
VELB-1. Avoid and minimize effects to species	a) If elderberry shrubs and valley elderberry longhorn beetle are anticipated within the project area, within 1 year before the commencement of ground-disturbing activities, a qualified biologist shall identify any elderberry shrubs in the project footprint. Qualified biologist(s) will survey potentially affected shrubs for valley elderberry longhorn beetle exit holes in stems greater than 1 inch in diameter. b) If elderberry shrubs are found on or adjacent to the construction project site, a 100-foot-wide avoidance buffer – measured from the dripline of the plant – will be established around all elderberry shrubs with stems greater than 1 inch in diameter at ground level and will be clearly identified in the field by staking, flagging, or fencing. No activities will occur within the buffer areas and worker awareness training and biological monitoring will be conducted to ensure that avoidance measures are being implemented.	Project and Program	USFWS
VELB -2. Compensate for temporary or permanent loss of habitat	a) The project proponent will consult with USFWS to determine appropriate compensation ratios. Compensatory mitigation measures will be consistent with the *Conservation Guidelines for Valley Elderberry Longhorn Beetle* (USFWS 1999a), or current guidance. b) Compensatory mitigation for adverse effects may include transplanting elderberry shrubs during the dormant season (November 1 to February 15), if feasible, to an area protected in perpetuity, as well as required additional elderberry and associated native plantings and approved by USFWS. c) If off-site compensation includes dedication of conservation easements, purchase of mitigation credits, or other off-site conservation measures, the details of these measures will be included in the mitigation plan and must occur with full endowments for management in perpetuity. The plan will include information on responsible parties for long-term management, holders of conservations easements, long-term management requirements, and other details, as appropriate, for the preservation of long-term viable populations.	Project and Program	USFWS

Table 4-5.
Conservation Measures for Biological Resources That May Be Affected by Settlement Actions (contd.)

Conservation Measure and Identifier	Applicable Habitat and/or Species, and Conservation Measure Description	Level of Compliance	Regulatory Agency
BNLL	**Blunt-nosed leopard lizard**		
BNLL-1. Avoid and minimize effects to species	a) Three areas have been identified as having potential blunt-nosed leopard lizard habitat based on aerial maps. These areas include approximately 2,460 acres along the southwest side of the San Joaquin River in Reach 2, approximately 490 acres in a portion of the Eastside Bypass and adjacent lands near Reach 4A of the San Joaquin River, and approximately 2,938 acres encompassing the northern side of the Mariposa Bypass and parcels north of the Mariposa Bypass and west of the Eastside Bypass. Within 1 year before the commencement of the proposed project, focused site visits and habitat assessment will be conducted on these lands. Based on focused assessment, and discussions with the USFWS and DFG, protocol-level surveys may be conducted. If blunt-nosed leopard lizard are detected within or adjacent to the project site, measures that will avoid direct take of this species will be developed in cooperation with USFWS and DFG and implemented before ground disturbing activities. (DWR 2010).	Project and Program	USFWS DFG
BNLL-2. Compensate for temporary or permanent loss of habitat or species	a) Compensation for impacts to the species, if needed, will be determined in coordination with USFWS and DFG as appropriate.	Program	USFWS DFG

Table 4-5.
Conservation Measures for Biological Resources That May Be Affected by Settlement Actions (contd.)

Conservation Measure and Identifier	Applicable Habitat and/or Species, and Conservation Measure Description	Level of Compliance	Regulatory Agency
PLANTS	**Other special-status plants**		
PLANTS-1. Avoid and minimize effects to special-status plants	a) Within 1 year before the commencement of ground-disturbing activities, habitat assessment surveys for the special-status plants listed in Table 1 of Appendix L of this Draft PEIS/R, "Biological Resources – Vegetation and Wildlife," will be conducted by a qualified botanist, in accordance with the most recent USFWS and DFG guidelines and at the appropriate time of year when the target species would be in flower or otherwise clearly identifiable. b) Locations of special-status plant populations will be clearly identified in the field by staking, flagging, or fencing a minimum 100-foot-wide buffer around them before the commencement of activities that may cause disturbance. No activity shall occur within the buffer area, and worker awareness training and biological monitoring will be conducted to ensure that avoidance measures are being implemented. c) Some special-status plant species are annual plants, meaning that a plant completes its entire life cycle in one growing season. Other special-status plant species are perennial plants that return year after year until they reach full maturity. Because of the differences in plant life histories, all general conservation measures will be developed on a case-by-case basis and will include strategies that are species- and site-specific to avoid impacts to special-status plants.	Program	USFWS DFG
PLANTS-2. Compensate for temporary or permanent loss of special-status plants	a) USFWS and/or DFG will be consulted to determine appropriate compensation measures for the loss of special-status plants, as appropriate. b) Appropriate mitigation measures may include the creation of off-site populations through seed collection or transplanting, preservation and enhancement of existing populations, restoration or creation of suitable habitat, or the purchase of credits at a regulatory-agency-approved mitigation bank. If off-site compensation includes dedication of conservation easements, purchase of mitigation credits, or other off-site conservation measures, the details of these measures will be included in the mitigation plan and must occur with full endowments for management in perpetuity. The plan will include information on responsible parties for long-term management, holders of conservations easements, long-term management requirements, and other details, as appropriate, for the preservation of long-term viable populations.	Program	USFWS DFG

Table 4-5.
Conservation Measures for Biological Resources That May Be Affected by Settlement Actions (contd.)

Conservation Measure and Identifier	Applicable Habitat and/or Species, and Conservation Measure Description	Level of Compliance	Regulatory Agency
GGS	**Giant garter snake**		
GGS-1. Avoid and minimize loss of habitat for giant garter snake	a) If giant garter snake habitat is anticipated to be present within the project area, preconstruction surveys will be completed by a qualified biologist approved by USFWS and DFG within a 24-hour period before any ground disturbance of potential giant garter snake habitat. If construction activities stop on the project site for a period of 2 weeks or more, a new giant garter snake survey will be completed no more than 24 hours before the restart of construction activities. Avoidance of suitable giant garter snake habitat, as defined by USFWS (USFWS 1993) and DFG, will occur by demarcating and maintaining a 300-foot-wide buffer around these areas. b) For projects within potential giant garter snake habitat, all activity involving disturbance of potential giant garter snake habitat will be restricted to the period between May 1 and October 1, the active season for giant garter snakes. The construction site shall be reinspected if a lapse in construction activity of 2 weeks or greater has occurred. c) Clearing will be confined to the minimal area necessary to facilitate construction activities. Giant garter snake habitat within or adjacent to the project will be flagged, staked, or fenced and designated as an Environmentally Sensitive Area. No activity shall occur within this area, and USFWS-approved worker awareness training and biological monitoring will be conducted to ensure that avoidance measures are being implemented. Construction activities shall be minimized within 200 feet of the banks of giant garter snake habitat. Movement of heavy equipment will be confined to existing roadways to minimize habitat disturbance. d) Vegetation shall be hand-cleared in areas where giant garter snakes are suspected to occur. Exclusionary fencing with one-way exit funnels shall be installed at least 1 month before activities to allow the species to passively leave the area and to prevent reentry into work zones, per USFWS and/or DFG guidance. e) If a giant garter snake is found during construction activities, USFWS, DFG, and the project's biological monitor will immediately be notified. The biological monitor, or his/her assignee, will stop construction in the vicinity of the find and allow the snake to leave on its own. The monitor will remain in the area for the remainder of the work day to ensure the snake is not harmed. Escape routes for giant garter snake should be determined in advance of construction and snakes will be allowed to leave on their own. If a giant garter snake does not leave on its own within 1 working day, USFWS and DFG will be consulted. f) All construction-related holes shall be covered to prevent entrapment of individuals. Where applicable, construction areas shall be dewatered 2 weeks before the start of activities to allow giant garter snakes and their prey to move out of the area before any disturbance.	Program	Lead Agency USFWS DFG

Table 4-5.
Conservation Measures for Biological Resources That May Be Affected by Settlement Actions (contd.)

Conservation Measure and Identifier	Applicable Habitat and/or Species, and Conservation Measure Description	Level of Compliance	Regulatory Agency
GGS-2. Compensate for temporary or permanent loss of habitat	a) Temporarily affected giant garter snake aquatic habitat will be restored in accordance with criteria listed in the USFWS *Mitigation Criteria for Restoration and/or Replacement of Giant Garter Snake Habitat* (Appendix A to Programmatic Formal Consultation for U.S. Army Corps of Engineers 404 Permitted Projects with Relatively Small Effects on the Giant Garter Snake Within Butte, Colusa, Glenn, Fresno, Merced, Sacramento, San Joaquin, Solano, Stanislaus, Sutter, and Yolo Counties, California (USFWS 1997)), or the most current criteria from USFWS or DFG. b) Permanent loss of giant garter snake habitat will be compensated at a ratio and in a manner consulted on with USFWS and DFG. Compensation may include preservation and enhancement of existing populations, restoration or creation of suitable habitat, or purchase of credits at a regulatory-agency-approved mitigation bank in sufficient quantity to compensate for the effect. Credit purchases, land preservation, or land enhancement to minimize effects to giant garter snakes should occur geographically close to the impact area. If off-site compensation is chosen, it shall include dedication of conservation easements, purchase of mitigation credits, or other off-site conservation measures, and the details of these measures will be included in the mitigation plan and must occur with full endowments for management in perpetuity. The plan will include information on responsible parties for long-term management, holders of conservations easements, long-term management requirements, and other details, as appropriate, for the preservation of long-term viable populations.	Program	USFWS DFG
WPT	**Western pond turtle**		
WPT-1. Avoid and minimize loss of individuals	a) A qualified biologist will conduct surveys in aquatic habitats to be dewatered and/or filled during project construction. Surveys will be conducted immediately after dewatering and before fill of aquatic habitat suitable for western pond turtles. If western pond turtles are found, the biologist will capture them and move them to nearby USFWS- and/or DFG-approved areas of suitable habitat that will not be disturbed by project construction.	Program	DFG

Table 4-5.
Conservation Measures for Biological Resources That May Be Affected by Settlement Actions (contd.)

Conservation Measure and Identifier	Applicable Habitat and/or Species, and Conservation Measure Description	Level of Compliance	Regulatory Agency
EAGLE	**Bald eagle and golden eagle**		
EAGLE-1. Avoid and minimize effects to bald and golden eagles (as defined in the Bald and Golden Eagle Protection Act)	a) Surveys for bald and golden eagle nests will be conducted within 2 miles of any proposed project within areas supporting suitable nesting habitat and important eagle roost sites and foraging areas. These surveys will be conducted in accordance with the USFWS *Protocol for Evaluating Bald Eagle Habitat and Populations in California* and DFG *Bald Eagle Breeding Survey Instructions* or current guidance (*USFWS Draft Project Design Criteria and Guidance for Bald and Golden Eagles)*. b) If an active eagle's nest is found, project disturbance will not occur within ½ mile of the active nest site during the breeding season (typically December 30 to July 1) or any project disturbance if it is shown to disturb the nesting birds. A no-disturbance buffer will be established around the nest site for construction activities in consultation with USFWS and DFG, and will depend on ecological factors, including topography, surrounding vegetation, nest height, and distance to foraging habitat, as well as the type and magnitude of disturbance. c) Project activity will not occur within the ½-mile-buffer areas, and worker awareness training and biological monitoring will be conducted to ensure that avoidance measures are being implemented.	Program	USFWS DFG
SWH	**Swainson's hawk**		
SWH-1. Avoid and minimize impacts to Swainson's Hawk	a) Preconstruction surveys for active Swainson's hawk nests will be conducted in and around all potential nest trees within 0.5 miles of project-related disturbance (including construction-related traffic).. b) If known or active nests are identified through preconstruction surveys or other means, a ½ mile no-disturbance buffer shall be established around all active nest sites if construction cannot be limited to occur outside the nesting season (February 15 through September 15). c) Worker awareness training and biological monitoring will be conducted to ensure that avoidance measures are being implemented.	Program	DFG
SWH-2. Compensate for loss of nest trees and foraging habitat	a) If foraging habitat for Swainson's hawk is removed in association with project implementation, foraging habitat compensation will occur in coordination with DFG. Foraging habitat mitigation may consist of planting and establishing alfalfa, row crops, pasture, or fallow fields. b) If potential nesting trees are to be removed during construction activities, removal will take place outside of Swainson's hawk nesting season, and the project proponent will develop a plan to replace known Swainson's hawk nest trees with a number of equivalent native trees that were previously determined to be impacts through consultation with DFG. Compensation shall include dedication of conservation easements, purchase of mitigation credits, or other off-site conservation measures, and the details of these measures will be included in the mitigation plan and must occur with full endowments for management in perpetuity. The plan will include information on responsible parties for long-term management, holders of conservations easements, long-term management requirements, and other details, as appropriate, for the preservation of long-term viable populations.	Program	DFG

Table 4-5.
Conservation Measures for Biological Resources That May Be Affected by Settlement Actions (contd.)

Conservation Measure and Identifier	Applicable Habitat and/or Species, and Conservation Measure Description	Level of Compliance	Regulatory Agency
RAPTOR	**Other nesting raptors**		
RAPTOR-1. Avoid and minimize loss of individual raptors	a) Construction activity, including vegetation removal, will only occur outside the typical breeding season for raptors (September 1 to February 14), if raptors are determined to be present. b) Preconstruction surveys will be conducted by a qualified biologist in areas of suitable habitat to identify active nests in the project footprint. c) If active nests are located in the project footprint, a no-disturbance buffer will be established until a qualified biologist determines that the nest is no longer active. The size of the buffer shall be established by a qualified biologist in coordination with DFG based on the sensitivity of the resource, the type of disturbance activity, and nesting stage. No activity shall occur within the buffer area, and worker awareness training and biological monitoring will be conducted to ensure that avoidance measures are being implemented.	Program	DFG
RAPTOR-2. Compensate for loss of nest trees	a) Native trees removed during project activities will be replaced with an appropriate number of native trees, in coordination with DFG.	Program	DFG
MBTA	**Other birds protected by the Migratory Bird Treaty Act**		
MBTA-1. Avoid and minimize effects to species	a) Native nesting birds will be avoided by not conducting project activity, including vegetation removal, during the typical breeding season (February 1 to September 1), if species covered under the Migratory Bird Treaty Act and Fish and Game Code Sections 3503, 3503.5, and 3513 are determined to be present. b) An Avian Protection Plan shall be established in coordination with USFWS and DFG. Any overhead utility companies within the project area, whose lines, poles, or towers may be moved in association with the project, will also be consulted as part of the Avian Protection Plan.	Program	USFWS DFG

Table 4-5.
Conservation Measures for Biological Resources That May Be Affected by Settlement Actions (contd.)

Conservation Measure and Identifier	Applicable Habitat and/or Species, and Conservation Measure Description	Level of Compliance	Regulatory Agency
BRO	**Burrowing owl**		
BRO-1. Avoid loss of species	a) Preconstruction surveys for burrowing owls will be conducted in areas supporting potentially suitable habitat and within 30 days before the start of construction activities. If ground-disturbing activities are delayed or suspended for more than 30 days after the preconstruction survey, the site should be resurveyed. b) Occupied burrows shall not be disturbed during the breeding season (February 1 through August 31). A minimum 160-foot-wide buffer shall be placed around occupied burrows during the nonbreeding season (September 1 through January 31), and a 250-foot-wide buffer shall be placed around occupied burrows during the breeding season. Ground-disturbing activities shall not occur within the designated buffers.	Program	DFG
BRO-2. Minimize impacts to species	a) If a DFG-approved biologist can verify through noninvasive methods that owls have not begun egg-laying and incubation, or that juveniles from occupied burrows are foraging independently and are capable of independent survival, a plan shall be coordinated with DFG to offset burrow habitat and foraging areas on the project site if burrows and foraging areas are taken by SJRRP actions. b) If destruction of occupied burrows occurs, existing unsuitable burrows should be enhanced (enlarged or cleared of debris) or new burrows created. This should be done in consultation with DFG. c) Passive owl relocation techniques must be implemented. Owls should be excluded from burrows in the immediate impact zone within a 160-foot-wide buffer zone by installing one-way doors in burrow entrances. These doors shall be in place at least 48 hours before excavation to insure the owls have departed. d) The project area shall be monitored daily for 1 week to confirm owl departure from burrows before any ground-disturbing activities. e) Where possible, burrows should be excavated using hand tools and refilled to prevent reoccupation. Sections of flexible plastic pipe should be inserted into the tunnels during excavation to maintain an escape route for any animals inside the burrow.	Program	DFG

Table 4-5.
Conservation Measures for Biological Resources That May Be Affected by Settlement Actions (contd.)

Conservation Measure and Identifier	Applicable Habitat and/or Species, and Conservation Measure Description	Level of Compliance	Regulatory Agency
BAT	**Special-status bats**		
BAT-1. Avoid and minimize loss of species	a) If suitable roosting habitat for special-status bats will be affected by project construction (e.g., removal of buildings, modification of bridges), surveys for roosting bats on the project site will be conducted by a qualified biologist. The type of survey will depend on the condition of the potential roosting habitat and may include visual surveys or use of acoustic detectors. Visual surveys may consist of a daytime pedestrian survey for evidence of bat use (e.g., guano) and/or an evening emergence survey for the presence or absence of bats. The type of survey will depend on the condition of the potential roosting habitat. If no bat roosts are found, then no further study is required. b) If evidence of bat use is observed, the number and species of bats using the roost will be determined. Bat detectors may be used to supplement survey efforts. c) If roosts are determined to be present and must be removed, the bats will be excluded from the roosting site before the facility is removed. A mitigation program addressing compensation, exclusion methods, and roost removal procedures will be developed in consultation with DFG before implementation. Exclusion methods may include use of one-way doors at roost entrances (bats may leave, but not reenter), or sealing roost entrances when a site can be confirmed to contain no bats. Exclusion efforts may be restricted during periods of sensitive activity (e.g., during hibernation or while females in maternity colonies are nursing young).	Program	DFG
BAT-2. Compensate for loss of habitat	a) The loss of each roost will be replaced, in consultation with DFG, and may include construction and installation of bat boxes suitable to the bat species and colony size excluded from the original roosting site. Roost replacement will be implemented before bats are excluded from the original roost sites. Once the replacement roosts are constructed and it is confirmed that bats are not present in the original roost sites, the structure may be removed.	Program	DFG

Table 4-5.
Conservation Measures for Biological Resources That May Be Affected by Settlement Actions (contd.)

Conservation Measure and Identifier	Applicable Habitat and/or Species, and Conservation Measure Description	Level of Compliance	Regulatory Agency
SJAS	**San Joaquin antelope squirrel**		
SJAS-1. Avoid and minimize loss of individuals	a) A 50-foot-wide minimum buffer shall be maintained from all small mammal burrows of suitable size for San Joaquin antelope squirrel. b) If work is to occur within the 50-foot-wide buffer, a qualified, permitted biologist shall conduct focused visual surveys for San Joaquin antelope squirrel within a 500-foot-wide buffer of the work area. These surveys shall coincide with the squirrels' most active season, April 1 to September 30, and shall be conducted only when air temperatures are between 20° to 30° C (68° to 86° F). Surveys should be conducted using daytime line transects with 10- to 30-meter spacing. Focused live trapping may also be required, in coordination with DFG. If San Joaquin antelope squirrels are observed during surveys, no vegetation or soil disturbance will be allowed within 50 feet of occupied burrows or burrow systems until the individuals are determined to no longer be occupying the area, as determined by a qualified biologist. c) Focused surveys, which may involve live trapping, may be required, in coordination with DFG, as appropriate. Additional conservation measures may develop pending the results of surveys, and in consultation with DFG. d) Construction activities shall be conducted when they are least likely to affect the species (i.e., after the normal breeding season). This timing shall be coordinated with USFWS and DFG.	Program	DFG
SJAS-2: Compensate for temporary or permanent loss of habitat or species	a) Compensation for impacts to the species, if needed, will be determined in coordination with DFG, as appropriate.	Program	DFG

Table 4-5.
Conservation Measures for Biological Resources That May Be Affected by Settlement Actions (contd.)

Conservation Measure and Identifier	Applicable Habitat and/or Species, and Conservation Measure Description	Level of Compliance	Regulatory Agency
FKR	**Fresno kangaroo rat**		
FKR-1. Avoid and minimize effects to species	a) Preconstruction surveys will be conducted by a qualified biologist per USFWS and DFG survey methodology to determine if potential burrows for Fresno kangaroo rat are present in the project footprint. Surveys will be conducted within 30 days before ground-disturbing activities. The biologist will conduct burrow searches by systematically walking transects, which shall be adjusted based on vegetation height and topography, and in coordination with USFWS and DFG. Transects shall be used to identify the presence of kangaroo rat burrows. When burrows are found within 100 feet of the proposed project footprint, focused live trapping surveys shall be conducted by a qualified and permitted biologist, following a methodology approved in advance by USFWS and DFG. Additional conservation measures may be developed pending the results of surveys, and in consultation with USFWS and DFG. b) Construction activities shall be conducted when they are least likely to affect the species (i.e., after the normal breeding season). This timing shall be coordinated with USFWS and DFG.	Program	USFWS DFG
FKR-2. Avoid disturbance of designated critical habitat	a) Facility construction and modification and other restoration projects shall be sited to avoid primary constituent elements of designated critical habitat for Fresno kangaroo rat.	Program	USFWS DFG
FKR-3: Compensate for temporary or permanent loss of habitat or species	a) Compensation for impacts to the species, if needed, will be determined in coordination with DFG and USFWS, as appropriate.	Program	USFWS DFG

Table 4-5.
Conservation Measures for Biological Resources That May Be Affected by Settlement Actions (contd.)

Conservation Measure and Identifier	Applicable Habitat and/or Species, and Conservation Measure Description	Level of Compliance	Regulatory Agency
SJKF	**San Joaquin kit fox**		
SJKF-1. Avoid and minimize effects to species	a) A qualified biologist will conduct preconstruction surveys no less than 14 days and no more than 30 days before the commencement of activities to identify potential dens more than 5 inches in diameter. The project proponent shall implement USFWS' (1999b) *Standardized Recommendations for Protection of San Joaquin Kit Fox Prior to or During Ground Disturbance.* The project proponent will notify USFWS and DFG in writing of the results of the preconstruction survey within 30 days after these activities are completed. b) If dens are located within the proposed work area, and cannot be avoided during construction activities, a USFWS-approved biologist will determine if the dens are occupied. c) If occupied dens are present within the proposed work, their disturbance and destruction shall be avoided. Exclusion zones will be implemented following the latest USFWS procedures (currently USFWS 1999b). d) The project proponent will notify USFWS and DFG immediately if a natal or pupping den is found in the survey area. The project proponent will present the results of preactivity den searches within 5 days after these activities are completed and before the start of construction activities in the area. e) Construction activities shall be conducted when they are least likely to affect the species (i.e., after the normal breeding season). This timing shall be coordinated with USFWS and DFG.	Program	USFWS DFG
SJKF-2. Compensate for loss of habitat	a) The project proponent, in coordination with USFWS and DFG, will determine if kit fox den removal is appropriate. If unoccupied dens need to be removed, the USFWS-approved biologist shall remove these dens by hand-excavating them in accordance with USFWS procedures (USFWS 1999b). b) Additional conservation measures will be coordinated with USFWS and DFG, and may include replacing dens, installing off-site artificial dens, acquiring compensation habitat, or other options to be determined. Compensation may include dedicating conservation easements, purchasing mitigation credits, or other off-site conservation measures, and the details of these measures will be included in the mitigation plan and must occur with full endowments for management in perpetuity. The plan will include information on responsible parties for long-term management, holders of conservations easements, long-term management requirements, and other details, as appropriate, for the preservation of long-term viable populations. c) The project proponent will present the results of den excavations to USFWS and DFG within 5 days after these activities are completed.	Program	USFWS DFG

Table 4-5.
Conservation Measures for Biological Resources That May Be Affected by Settlement Actions (contd.)

Conservation Measure and Identifier	Applicable Habitat and/or Species, and Conservation Measure Description	Level of Compliance	Regulatory Agency
PL	**Pacific lamprey**		
PL-1. Avoid and minimize effects to species	a) A qualified biologist will conduct preconstruction surveys as outlined in Attachment A of USFWS' *Best Management Practices to Minimize Adverse Effects to Pacific Lamprey (Entosphenus tridentatus)* (2010). b) Work in documented areas of Pacific lamprey presence will be timed to avoid in-channel work during typical lamprey spawning (March 1 to July 1). c) If temporary dewatering in documented areas of lamprey presence is required for instream channel work, salvage methods shall be implemented to capture and move ammocoetes to a safe area, in consultation with USFWS.	Program	USFWS
DS	**Delta smelt**		
DS-1. Avoid and minimize effects to species	a) All in-water work within delta smelt habitat, as defined by most recent USFWS guidance, shall be confined to a seasonal work window of August 1 - November 30, when delta smelt are least likely to be present. Because this species does not regulate its movements strictly within this time frame, modifications to the work windows may be approved by USFWS before project implementation, based on information from the various in-Delta monitoring programs. b) If activities occur within Delta smelt habitat, measure will be taken to maintain or increase shading of suitable shallow water habitat. The project will also avoid areas deemed suitable for delta smelt habitat that have established aquatic vegetation or have not been previously disturbed.	Program	USFWS DFG
RHSNC	**Riparian habitat and other sensitive natural communities**		
RHSNC-1. Avoid and minimize loss of riparian habitat and other sensitive natural communities	a) Biological surveys will be conducted to identify, map, and quantify riparian and other sensitive habitats in potential construction areas. b) Construction activities will be avoided in areas containing sensitive natural communities, as appropriate. c) If effects occur to riparian habitat, emergent wetland, or other sensitive natural communities associated with streams, the State lead agency will comply with Section 1602 of the California Fish and Game Code; compliance may include measures to protect fish and wildlife resources during the project.	Project and Program	DFG

Table 4-5.
Conservation Measures for Biological Resources That May Be Affected by Settlement Actions (contd.)

Conservation Measure and Identifier	Applicable Habitat and/or Species, and Conservation Measure Description	Level of Compliance	Regulatory Agency
RHSNC-2. Compensate for loss of riparian habitat and other sensitive natural communities	a) The Riparian Habitat Mitigation and Monitoring Plan for the SJRRP will be developed and implemented in coordination with DFG. Credits for increased acreage or improved ecological function or riparian and wetland habitats resulting from the implementation of SJRRP actions will be applied as compensatory mitigation before additional compensatory measures are required. b) If losses of other sensitive natural communities (e.g., recognized as sensitive by CNDDB, but not protected under other regulations or policies) would not be offset by the benefits of the SJRRP, then additional compensation will be provided through creating, restoring, or preserving in perpetuity in-kind communities at a sufficient ratio for no net loss of habitat function or acreage. The appropriate ratio will be determined in consultation with USFWS or DFG, depending on agency jurisdiction.	Project and Program	DFG
WUS	**Waters of the United States/waters of the State**		
WUS-1. Identify and quantify wetlands and other waters of the United States	a) Before SJRRP actions that may affect waters of the United States or waters of the State, Reclamation will map the distribution of wetlands (including vernal pools and other seasonal wetlands) in the Eastside and Mariposa bypasses. b) The project proponent will determine, based on the mapped distribution of these wetlands and hydraulic modeling and field observation, the acreage of effects, if any, on waters of the United States. c) If it is determined that vernal pools or other seasonal wetlands will be affected by the SJRRP, the project proponent will conduct a delineation of waters of the United States, and submit the delineation to USACE for verification. The delineation will be conducted according to methods established in the USACE *Wetlands Delineation Manual* (Environmental Laboratory 1987) and *Arid West Supplement* (Environmental Laboratory 2008). d) Construction and modification of road crossings, control structures, fish barriers, fish passages, and other structures will be designed to minimize effects on waters of the United States and waters of the State, and will employ BMPs to avoid indirect effects on water quality.	Project and Program	USACE
WUS-2. Obtain permits and compensate for any loss of wetlands and other waters of the United States/waters of the State	a) The project proponent, in coordination with USACE, will determine the acreage of effects on waters of the United States and waters of the State that will result from implementation of the SJRRP. b) The project proponent will adhere to a “no net loss” basis for the acreage of wetlands and other waters of the United States and waters of the State that will be removed and/or degraded. Wetland habitat will be restored, enhanced, and/or replaced at acreages and locations and by methods agreed on by USACE and the Central Valley RWQCB, as appropriate, depending on agency jurisdiction. c) The project proponent will obtain Section 404 and Section 401 permits and comply with all permit terms. The acreage, location, and methods for compensation will be determined during the Section 401 and Section 404 permitting processes. d) The compensation will be consistent with recommendations in the Fish and Wildlife Coordination Act Report (Appendix F of this Draft PEIS/R).	Project and Program	USACE

Table 4-5.
Conservation Measures for Biological Resources That May Be Affected by Settlement Actions (contd.)

Conservation Measure and Identifier	Applicable Habitat and/or Species, and Conservation Measure Description	Level of Compliance	Regulatory Agency
INV	**Invasive plants**		
INV-1. Implement the Invasive Vegetation Monitoring and Management Plan	a) Reclamation and the project lead agencies will implement the Invasive Vegetation Monitoring and Management Plan for the SJRRP (Appendix L of this Draft PEIS/R), which includes measures to monitor, control, and where possible eradicate, invasive plant infestations during flow releases and construction activities. b) The implementation of the Invasive Vegetation Monitoring and Management Plan (Appendix L of this Draft PEIS/R) will include monitoring procedures, thresholds for management responses, success criteria, and adaptive management measures for controlling invasive plant species. c) The control of invasive weeds and other recommended actions in the Invasive Vegetation Monitoring and Management Plan (Appendix L of this Draft PEIS/R) will be consistent with recommendations in the Fish and Wildlife Coordination Act Report (Appendix F of this Draft PEIS/R).	Project and Program	Lead Agency
CP	**Conservation plans**		
CP-1. Remain consistent with approved conservation plans	a) Facility siting and construction activities will be conducted in a manner consistent with the goals and strategies of adopted habitat conservation plans, natural community conservation plans, or other approved local, regional, or State habitat conservation plans to the extent feasible. Coordination shall occur with USFWS and/or DFG, as appropriate.	Program	USFWS DFG
CP-2. Compensate effects consistent with approved conservation plans	a) The project proponent shall compensate effects consistent with applicable conservation plans and implement all applicable measures required by the plans.	Program	USFWS DFG
GS	**Southern distinct population segment of North American green sturgeon**		
GS-1. Avoid and minimize loss of habitat and individuals	a) The SJRRP will be operated in such a way that actions within green sturgeon habitat shall be done in accordance with existing operating criteria of the CVP and SWP, and prevailing and relevant laws, regulations, BOs, and court orders in place when the action(s) are performed.	Project and Program	NMFS

Table 4-5.
Conservation Measures for Biological Resources That May Be Affected by Settlement Actions (contd.)

Conservation Measure and Identifier	Applicable Habitat and/or Species, and Conservation Measure Description	Level of Compliance	Regulatory Agency
CVS	**Central Valley steelhead**		
CVS-1. Avoid loss of habitat and risk of take of species	a) Impacts to habitat conditions (i.e., changes in flows potentially resulting in decreased flows in the tributaries, increases in temperature, increases in pollutant concentration, change in recirculation/recapture rates and methods, decrease in floodplain connectivity, removal of riparian vegetation, decreased in quality rearing habitat, etc.) must be analyzed in consultation with NMFS. b) The Hills Ferry Barrier will be operated and maintained to exclude Central Valley steelhead from the Restoration Area during construction activities and until suitable habitat conditions are restored. c) Maintenance of conservation measures will be conducted to the extent necessary to ensure that the overall long-term habitat effects of the project are positive. d) Before implementation of site-specific actions, the action agency shall conduct an education program for all agency and contracted employees relative to the Federally listed species that may be encountered within the study area of the action, and required practices for their avoidance and protection. A NMFS-appointed representative shall be identified to employees and contractors to ensure that questions regarding avoidance and protection measures are addressed in a timely manner. e) Disturbance of riparian vegetation will be avoided to the greatest extent practicable. f) A spill prevention plan will be prepared describing measures to be taken to minimize the risk of fluids or other materials used during construction (e.g., oils, transmission and hydraulic fluids, cement, fuel) from entering the San Joaquin River or contaminating riparian areas adjacent to the river itself. In addition to a spill prevention plan, a cleanup protocol will be developed before construction begins and shall be implemented in case of a spill. g) Stockpiling of materials, including portable equipment, vehicles and supplies, such as chemicals, shall be restricted to the designated construction staging areas, exclusive of any riparian and wetland areas. h) A qualified biological monitor will be present during all construction activities, including clearing, grubbing, pruning, and trimming of vegetation at each job site during construction initiation, midway through construction, and at the close of construction, to monitor implementation of conservation measures and water quality. i) The San Joaquin River channel shall be designed to decrease or eliminate predator holding habitat, in coordination with NMFS.	Project and Program	NMFS

Table 4-5.
Conservation Measures for Biological Resources That May Be Affected by Settlement Actions (contd.)

Conservation Measure and Identifier	Applicable Habitat and/or Species, and Conservation Measure Description	Level of Compliance	Regulatory Agency
CVS-2. Minimize loss of habitat and risk of take of species	a) In-channel construction activities that could affect designated critical habitat for Central Valley steelhead will be limited to the low-flow period between June 1 and October 1 to minimize potential for adversely affecting Federally listed anadromous salmonids during their emigration period. b) In-channel construction activities that could affect designated critical habitat for Central Valley steelhead will be limited to daylight hours during weekdays, leaving a nighttime and weekend period of passage for Federally listed fish species. c) Construction BMPs for off-channel staging, and storage of equipment and vehicles, will be implemented to minimize the risk of contaminating the waters of the San Joaquin River by spilled materials. BMPs will also include minimization of erosion and stormwater runoff, as appropriate. d) Riparian vegetation removed or damaged will be replaced at a ratio, coordinated with NMFS, within the immediate area of the disturbance to maintain habitat quality. e) If individuals of listed species are observed present within a project area, NMFS must be notified. NMFS personnel shall have access to construction sites during construction, and following completion, to evaluate species presence and condition and/or habitat conditions. f) If bank stabilization activities should be necessary, then such stabilization shall be constructed to minimize predator habitat, minimize erosion potential, and contain material suitable for supporting riparian vegetation.	Program	NMFS
WRCS	**Sacramento Valley winter-run Chinook salmon**		
WRCS-1. Avoid and minimize loss of habitat and individuals	a) The SJRRP will be operated in such a way that actions related to the SJRRP in the vicinity of winter-run Chinook salmon habitat shall be performed in accordance with existing operating criteria of the CVP and SWP, and prevailing and relevant laws, regulations, BOs, and court orders in place at the time the actions are performed.	Project and Program	NMFS DFG
SRCS	**Central Valley spring-run Chinook salmon**		
SRCS-1. Avoid and minimize loss of habitat and individuals	a) The SJRRP will be operated in such a way that actions in the vicinity of spring-run Chinook salmon habitat shall be done in accordance with existing operating criteria of the CVP and SWP, and prevailing and relevant laws, regulations, BOs, and court orders in place at the time the actions are performed. b) SJRRP actions shall be performed in accordance with the Experimental Population 4(d) rule, as it is developed, and where applicable.	Project and Program	NMFS DFG

Table 4-5.
Conservation Measures for Biological Resources That May Be Affected by Settlement Actions (contd.)

Conservation Measure and Identifier	Applicable Habitat and/or Species, and Conservation Measure Description	Level of Compliance	Regulatory Agency
EFH	**Essential fish habitat (Pacific salmonids and starry flounder)**		
EFH-1. Avoid loss of habitat and risk of take of species	a) Impacts to habitat conditions (e.g., changes in flows potentially resulting in decreased flows in the tributaries, increases in temperature, increases in pollutant concentration, change in recirculation/recapture rates and methods, decrease in floodplain connectivity, removal of riparian vegetation, decreased in quality rearing habitat) must be analyzed in consultation with NMFS. b) The Hills Ferry Barrier will be operated and maintained to exclude Pacific salmonids from the Restoration Area during construction activities, and until suitable habitat conditions are restored. c) Maintenance of conservation measures will be conducted to the extent necessary to ensure that the overall long-term habitat effects of the project are positive. d) Before implementation of site-specific actions, the action agency shall conduct an education program for all agency and contracted employees relative to the Federally listed species that may be encountered within the study area of the action, and required practices for their avoidance and protection. A NMFS-appointed representative shall be identified to employees and contractors to ensure that questions regarding avoidance and protection measures are addressed in a timely manner. e) Disturbance of riparian vegetation will be avoided to the greatest extent practicable. f) A spill prevention plan will be prepared describing measures to be taken to minimize the risk of fluids or other materials used during construction (e.g., oils, transmission and hydraulic fluids, cement, fuel) from entering the San Joaquin River or contaminating riparian areas adjacent to the river itself. In addition to a spill prevention plan, a cleanup protocol will be developed before construction begins and shall be implemented in case of a spill. g) Stockpiling of materials, including portable equipment, vehicles and supplies, such as chemicals, shall be restricted to the designated construction staging areas, exclusive of any riparian and wetland areas. h) A qualified biological monitor will be present during all construction activities, including clearing, grubbing, pruning, and trimming of vegetation at each job site during construction initiation, midway through construction, and at the close of construction to monitor implementation of conservation measures and water quality. i) The bottom topography of the San Joaquin River channel will be designed to decrease or eliminate predator holding habitat.	Project and Program	NMFS

Table 4-5.
Conservation Measures for Biological Resources That May Be Affected by Settlement Actions (contd.)

Conservation Measure and Identifier	Applicable Habitat and/or Species, and Conservation Measure Description	Level of Compliance	Regulatory Agency
EFH-2. Minimize loss of habitat and risk of take from implementation of construction activities	a) In-channel construction activities that could affect habitat for will be limited to the low-flow period between June 1 and October 1 to minimize potential for adversely affecting Federally listed anadromous salmonids during their emigration period. b) In-channel construction activities that could affect habitat for starry flounder and Pacific salmonids will be limited to daylight hours during weekdays, leaving a nighttime and weekend period of passage for Federally listed fish species. c) Construction BMPs for off-channel staging and storage of equipment and vehicles will be implemented to minimize the risk of contaminating the waters of the San Joaquin River by spilled materials. BMPs will also include minimization of erosion and stormwater runoff, as appropriate. d) Riparian vegetation removed or damaged will be replaced at a ratio, coordinated with NMFS, within the immediate area of the disturbance to maintain habitat quality. e) If individuals of listed species are observed present within a project area, NMFS must be notified. NMFS personnel shall have access to construction sites during construction and following completion to evaluate species presence and condition and/or habitat conditions. f) If bank stabilization activities should be necessary, then such stabilization shall be constructed to minimize predator habitat, minimize erosion potential, and contain material suitable for supporting riparian vegetation.	Program	NMFS

Key:
°C = degrees Celsius
°F = degrees Fahrenheit
BMP = best management practice
BO = Biological Opinion
CFR = Code of Federal Regulations
cfs = cubic feet per second
CNDDB = California Natural Diversity Database
CVP = Central Valley Project
DFG = California Department of Fish and Game
DWR = California Department of Water Resources
EPA = Federal Environmental Protection Agency
NMFS = National Marine Fisheries Service
PEIS/R = Program Environmental Impacts Statement/Report
Reclamation = U.S. Department of the Interior, Bureau of Reclamation
RWQCB = Regional Water Quality Control Board
Settlement = Stipulation of Settlement in *NRDC, et al,. v. Kirk Rodgers, et al.*
SJRRP = San Joaquin River Restoration Program
State = State of California
SWP = State Water Project
USACE = U.S. Army Corps of Engineers
USFWS = U.S. Fish and Wildlife Service

4.3 Alternative A2 Reach 4B1 at 4,500 cfs, Delta Recapture

Project-level actions in Alternative A2 are identical to project-level actions in Alternative A1. Program-level actions in Alternative A2 include all of the program-level actions in Alternative A1, plus additional Restoration actions in Reach 4B1 and the bypass system to increase the capacity of Reach 4B1, as described below and as shown in Table 2-2. Flow routing and water recapture under Alternative A2 are shown in Figure 4-6.

4.3.1 Additional Restoration Actions

Alternative A2 includes all of the modifications to Reach 4B1 described in Alternative A1 plus additional modifications needed to increase the capacity of Reach 4B1 to at least 4,500 cfs, with integrated floodplain habitat, as specified in Paragraph 11(b)(1) of the Settlement. The additional modifications to increase the capacity of Reach 4B1 to at least 4,500 cfs would be implemented during Phase 2, unless the Secretary, in consultation with the RA and with concurrence by NMFS and USFWS, determines that such modifications would not substantially enhance achievement of the Restoration Goal. These modifications to Reach 4B1 would require subsequent environmental compliance documentation, and would include modifications to the San Joaquin River Headgates at the upstream end of Reach 4B1 to provide for fish passage, and enable flow routing of between 500 cfs and 4,500 cfs into Reach 4B1, and related modifications to the Sand Slough Control Structure, as stipulated in Paragraphs 11(a)(4) and 11(a)(5) of the Settlement, respectively.

Before modifications are completed to convey at least 4,500 cfs in Reach 4B1, Interim and Restoration flows of up to 475 cfs would be routed through Reach 4B1, with remaining Interim and Restoration flows routed through the Eastside Bypass. After modifications are completed to convey at least 4,500 cfs through Reach 4B1, all Interim and Restoration flows would be routed through Reach 4B1. Modifications to and operations of Reach 4B1, the San Joaquin River Headgate, and the Sand Slough Control Structure to convey at least 4,500 cfs through Reach 4B1 in Alternative A2 are the same in Alternatives B2 and C2, as shown in Figures 2-2 and 2-8, and therefore are not discussed further in the presentation of those alternatives.

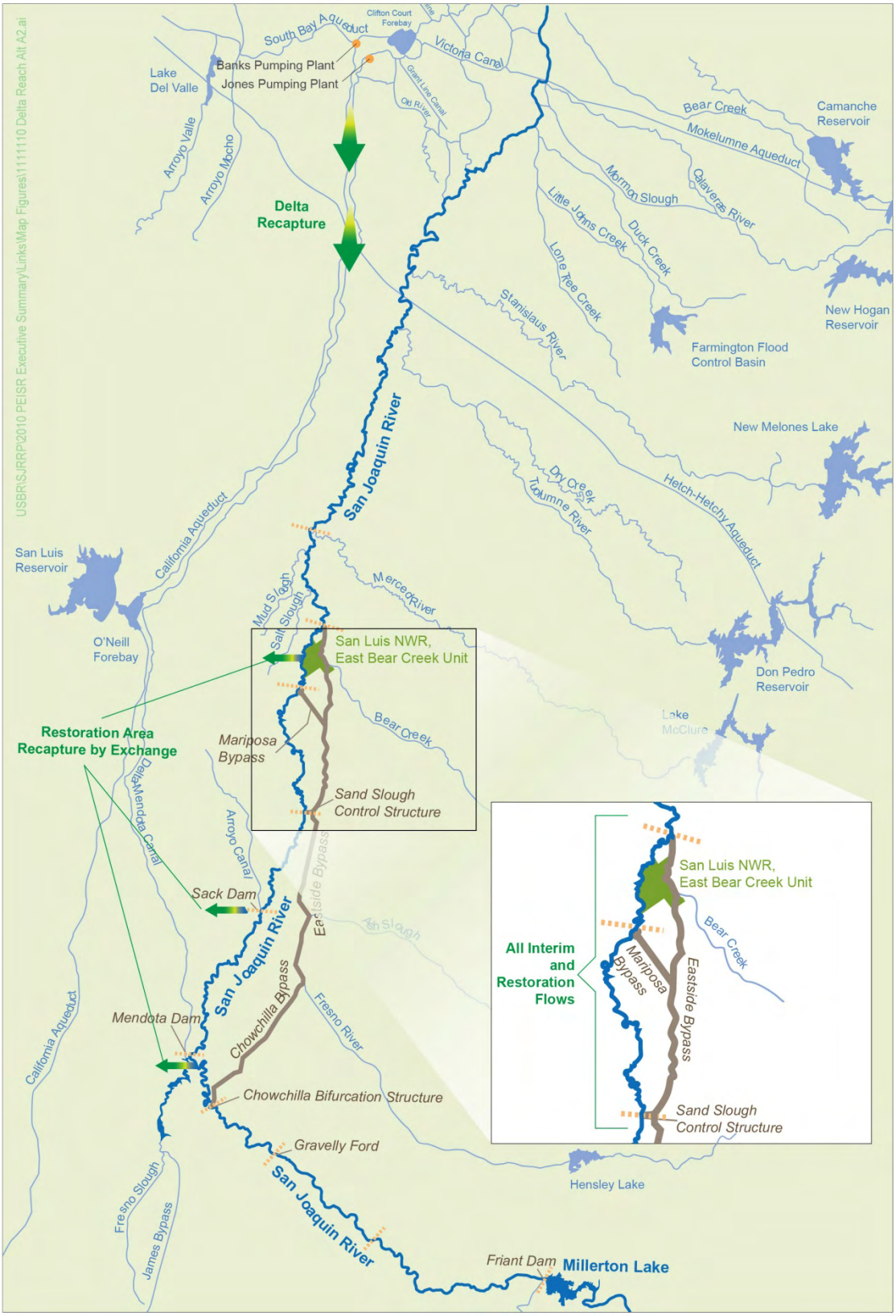


Figure 4-6.
Flow Routing and Water Recapture Under Alternative A2

Although the exact extent of potential floodplain habitat through Reach 4B1 has not been identified, floodplains in Reach 4B1 could provide significant benefits for salmon and other native fish. Therefore, Alternative A2 includes modifications to Reach 4B1 that bracket a reasonable range of potential implementation. New levees would be constructed in Reach 4B1 to provide new floodplain habitat ranging in average width from about 1,900 feet to 4,800 feet, and levee heights at an average of 4 feet to 5 feet, depending on the characteristics of the floodplain habitat. Specific levee alignments, modifications, and floodplain characteristics would be determined through a project-specific study that would consider a variety of factors, as specified in the Act, including, but not limited to, fisheries and other ecological requirements, flood risk reduction, land uses, subsurface conditions, topography, and the condition of existing levees. The Fisheries Management Plan (Appendix E) addresses specific actions to improve habitats and evaluates their merits (including uncertainty) in an action routing process.

Road crossings are present at several locations in Reach 4B1. Washington Road crosses the river just downstream from the San Joaquin River Headgates. Turner Island Road crosses the river approximately midway along the reach. Three unnamed crossings are also present in Reach 4B1, as described in Alternative A1. These crossings would be modified to provide flow capacity and fish passage, if necessary. Project-specific studies of these crossings would identify specific modifications needed to facilitate flow and fish passage.

4.4 Alternative B1
Reach 4B1 at 475 cfs, San Joaquin River Recapture

Project-level actions in Alternative B1 are identical to project-level actions in Alternatives A1 and A2. Program-level actions in Alternative B1 include all of the program-level actions in Alternative A1, plus additional Water Management actions to recapture Interim and Restoration flows using existing facilities along the San Joaquin River between the Merced River and the Delta, as shown in Table 2-2. Flow routing and water recapture under Alternative B1 are shown in Figure 4-7.

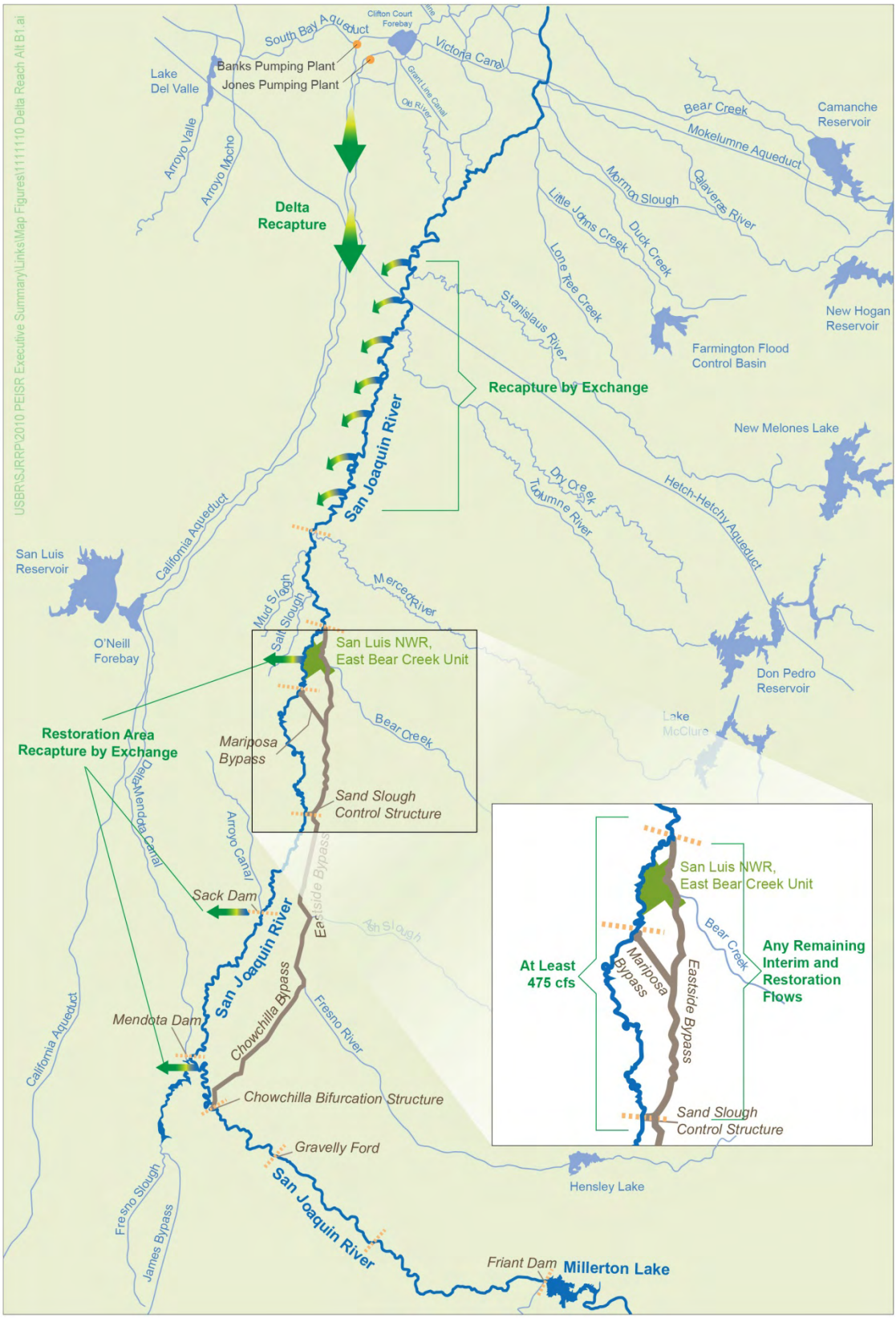


Figure 4-7.
Flow Routing and Water Recapture Under Alternative B1

4.4.1 Additional Water Management Actions on San Joaquin River

Alternative B1 includes recapturing Interim and Restoration flows from the San Joaquin River below the Merced River confluence at existing pumping facilities owned and operated by CVP contractors who possess San Joaquin River water rights, as illustrated in Figure 4-7. These actions could include potential in-district modifications to existing off-river facilities to facilitate routing or storage of water, such as expanding existing canals or constructing lift stations on existing canals. These actions are analyzed at a program level in this Draft PEIS/R. Recaptured Interim and Restoration flows from the San Joaquin River would be exchanged for CVP Delta water supplies scheduled for delivery to these CVP contractors. Implementing recapture at existing facilities on the San Joaquin River would require agreements with San Joaquin River water right holders to allow pumping of Interim and Restoration flows in exchange for delivery of CVP water from the Delta. Recapture of Interim or Restoration flows at existing facilities would occur only if doing so would not adversely affect downstream water quality or fisheries, consistent with the requirements of Paragraph 16(a)(1) of the Settlement. To the extent they are available, CVP storage and conveyance facilities would be used to convey the exchanged water to the Friant Division. As a result of these diversions along the San Joaquin River, the portion of the Restoration Flows reaching the Delta under Alternative B1 would be less than under Alternative A1.

Water supply recaptured through exchange with San Joaquin River water right holders available to Friant Division long-term contractors would range from zero to the total amount of recaptured Interim and Restoration flows. Recapture would be limited by conveyance capacity and conditions identified by exchanging entities, such as water quality requirements for land application or other potential concerns.

Implementing Alternative B1 would require exchange and/or conveyance agreements between Reclamation and CVP water users who possess water rights on the San Joaquin River. This alternative also would require exchange and/or conveyance agreements for recirculating recaptured Interim and Restoration flows at Delta export pumping facilities, as described under Alternative A1.

4.5 Alternative B2 Reach 4B1 at 4,500 cfs, San Joaquin River Recapture

Project-level actions in Alternative B2 are identical to project-level actions in Alternatives A1, A2, and B1. Program-level actions in Alternative B2 include all of the program-level actions in Alternative B1, plus additional Restoration actions in Reach 4B1 and the bypass system to increase the capacity of Reach 4B1 to at least 4,500 cfs, as described for Alternative A2, as shown in Table 2-2. Flow routing and water recapture under Alternative B2 are shown in Figure 4-8.

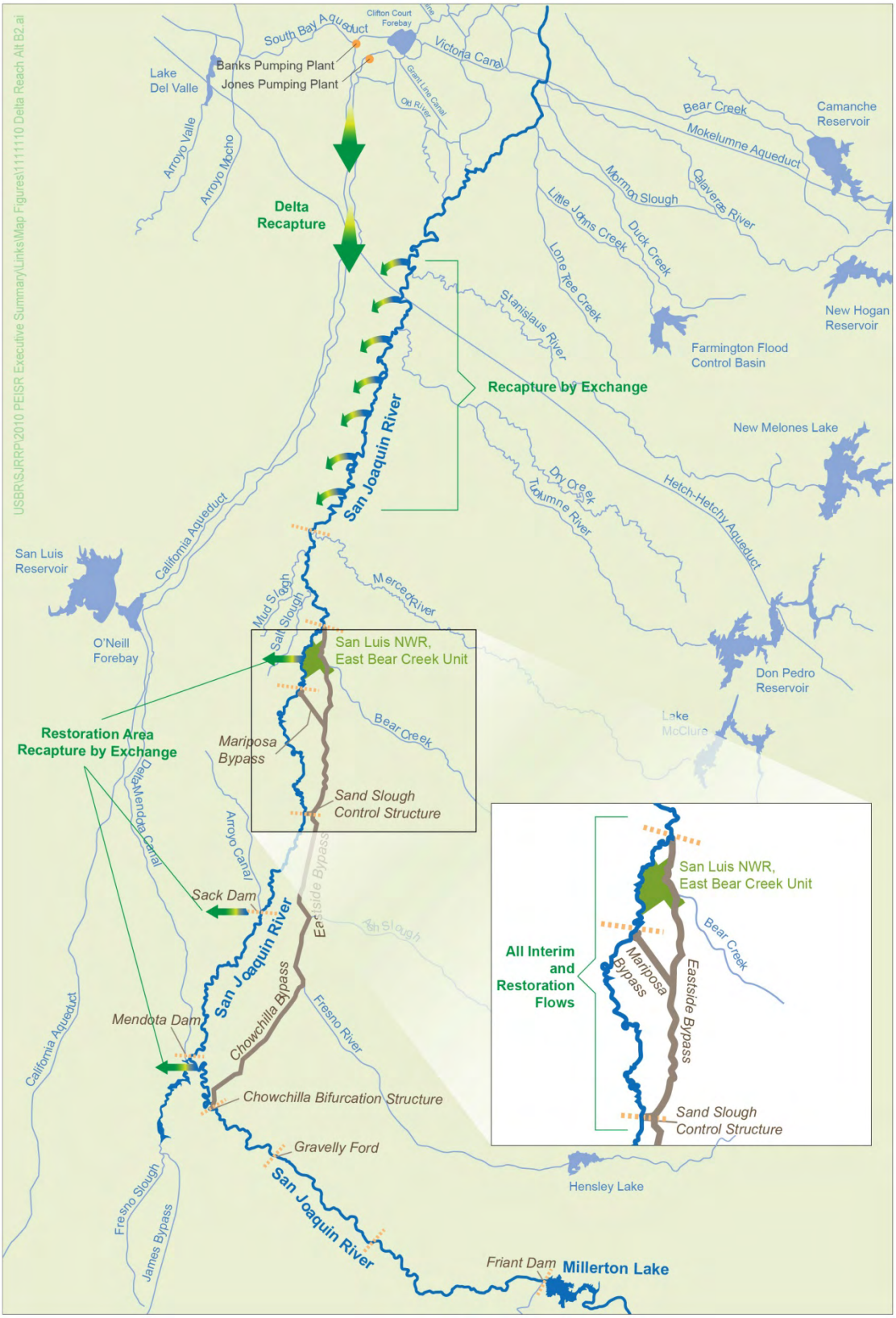


Figure 4-8.
Flow Routing and Water Recapture Under Alternative B2

4.6 Alternative C1 Reach 4B1 at 475 cfs, New Pumping Infrastructure Recapture

Project-level actions in Alternative C1 are identical to project-level actions in alternatives A1, A2, B1, and B2. Program-level actions in Alternative C1 include all of the program-level actions in Alternative B1, plus additional Water Management actions for constructing and operating new infrastructure to facilitate recapture of Interim and Restoration flows on the San Joaquin River below the confluence of the Merced River, as described below and as shown in Table 2-2. Flow routing and water recapture under Alternative C1 are shown in Figure 4-9.

4.6.1 Additional Water Management Actions on San Joaquin River

In addition to water exchanges with existing water right holders along the San Joaquin River, Alternative C1 also includes constructing new infrastructure to increase pumping capacity along the San Joaquin River below the Merced River confluence for the direct recapture of Interim and Restoration flows, and infrastructure to convey recaptured flows to the DMC or California Aqueduct. Construction of new pumping capacity would include a new pumping plant on the San Joaquin River or enlarging the pumping capacity of an existing facility on the San Joaquin River. This action is analyzed at a program level in this Draft PEIS/R. Before completion of new pumping capacity on the river, recapture would occur in the Delta, as described under Alternatives A1 and A2, and/or at existing facilities along the river, as described under Alternatives B1 and B2. After construction of new pumping capacity, a smaller portion of Restoration Flows would reach the Delta under Alternative C1 than under Alternative B1, because of the additional recapture that would be possible along the San Joaquin River at the new pumping infrastructure. A smaller portion of Interim and Restoration Flows would be available for recapture through exchange at existing facilities under Alternative C1 than under Alternative B1 because of recapture of flows at the new pumping infrastructure.

The new pumping infrastructure could have a capacity of up to 1,000 cfs, and would be located on the San Joaquin River downstream from the Merced River confluence and upstream from Vernalis. This river reach includes a range of anticipated flows and water quality conditions that would affect design and operation of the facility; therefore, the location and capacity of the pumping infrastructure would be determined as part of a subsequent site-specific study. New pumping infrastructure would also include infrastructure to convey recaptured flows to the DMC or California Aqueduct. To the extent they are available, existing south-of-Delta CVP and SWP storage and conveyance facilities would be used to recirculate recaptured water to the Friant Division, as described for Alternative B1.

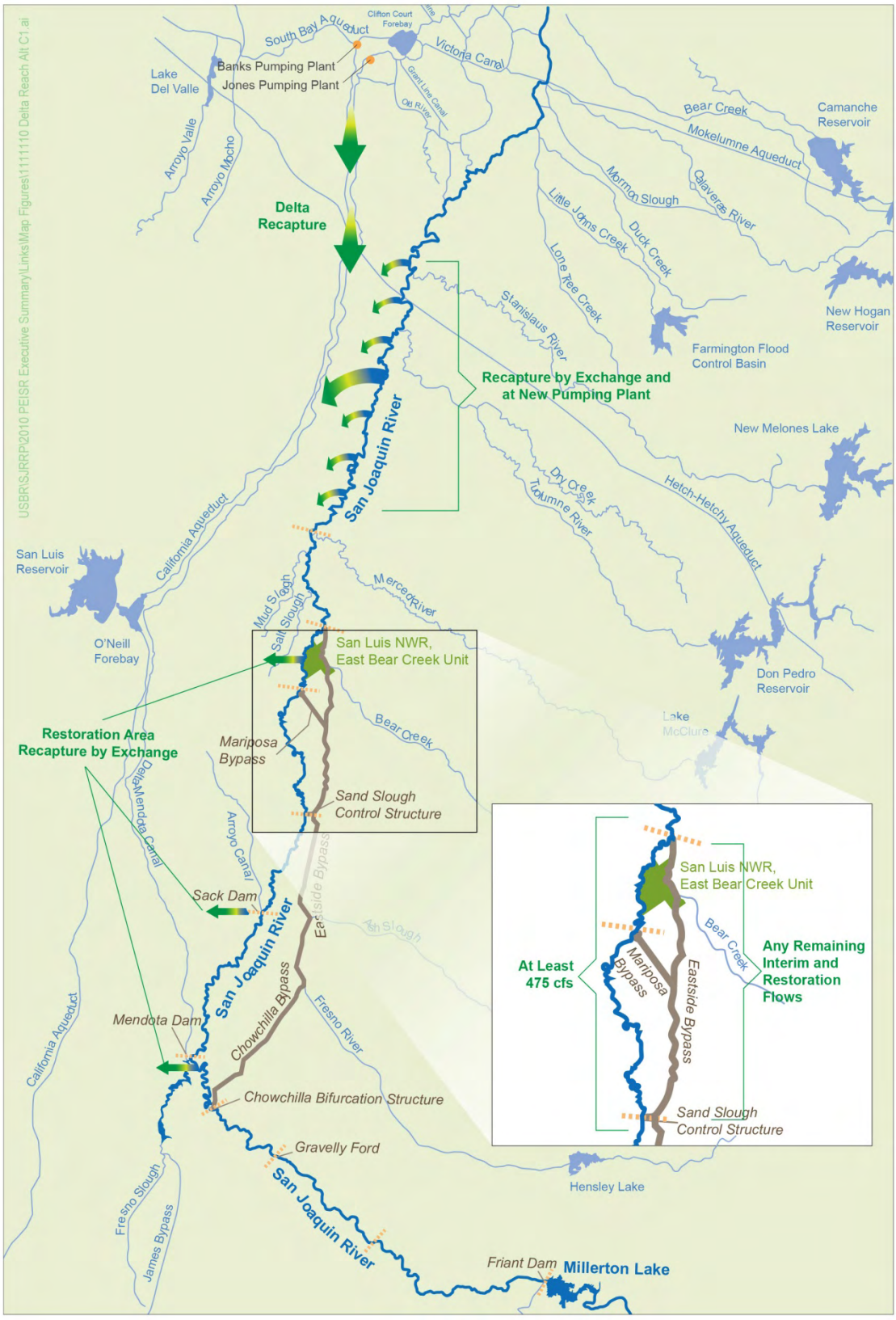


Figure 4-9.
Flow Routing and Water Recapture Under Alternative C1

The availability of water would be limited to direct recapture of Interim and Restoration flows in the San Joaquin River and in the Delta. Recaptured water available to Friant Division long-term contractors would range from zero to the total amount of recaptured Interim and Restoration flows, and would be limited by conveyance capacity and water quality requirements for introducing recaptured water to the DMC and California Aqueduct. The conveyance of water would be limited by physical pumping plant capacity, permit limitations for pumping from the San Joaquin River, and available conveyance capacity in the DMC and the California Aqueduct. New water right permits, or modifications to existing permits, would be needed to redivert water from the San Joaquin River at new pumping infrastructure.

4.7 Alternative C2 Reach 4B1 at 4,500 cfs, New Pumping Infrastructure Recapture

Project-level actions in Alternative C2 are identical to project-level actions in Alternatives A1, A2, B1, B2, and C1. Program-level actions in Alternative C2 include all of the program-level actions in Alternative C1, plus additional Restoration actions in Reach 4B1 and the bypass system, to increase the capacity of Reach 4B1 to at least 4,500 cfs, as described for Alternative A2 and as shown in Table 2-2. Flow routing and water recapture under Alternative C1 are shown in Figure 4-10.

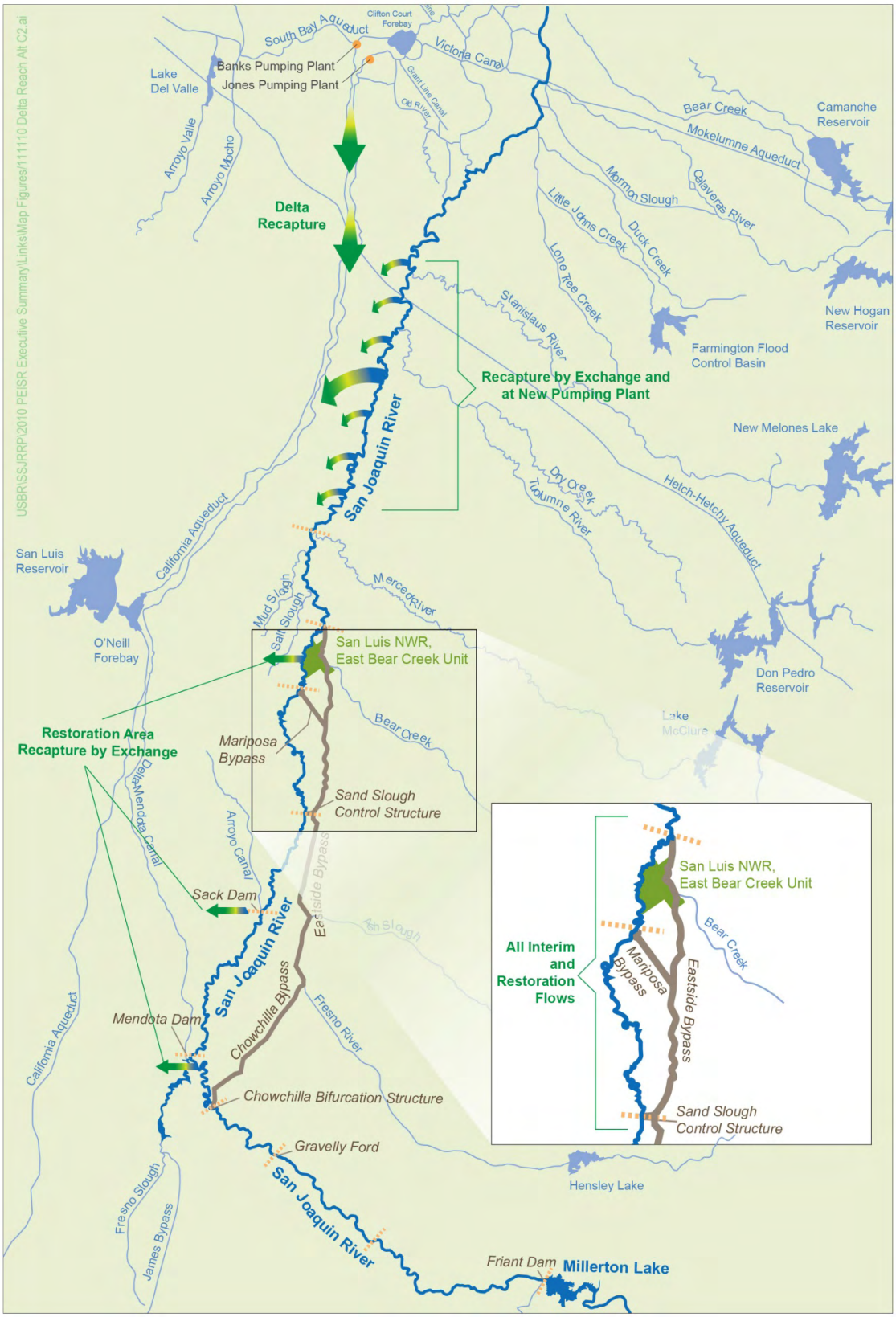


Figure 4-10.
Flow Routing and Water Recapture Under Alternative C2

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