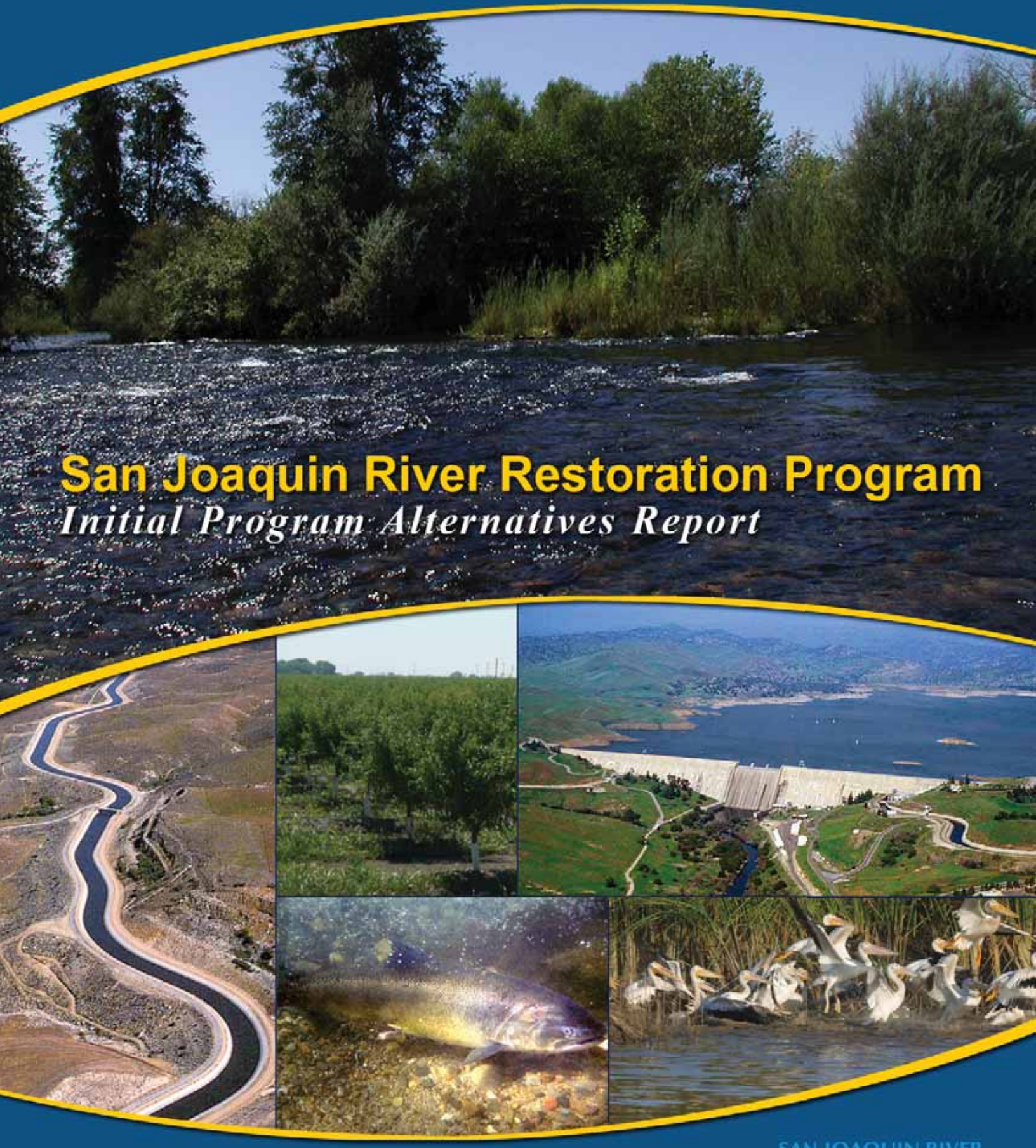
San Joaquin River Restoration Program

Initial Program Alternatives Report



SAN JOAQUIN RIVER RESTORATION PROGRAM

JUNE 2008

This report was prepared by the San Joaquin River Restoration Program (SJRRP) Team in support of preparing a Program Environmental Impact Statement/Report (PEIS/R). The purpose for circulating this document at this time is to facilitate coordination regarding initial concepts and approaches currently under consideration by the SJRRP Team with the Settling Parties, Third Parties, other stakeholders, and interested members of the public. Accordingly, this report does not present findings, decisions, or policy statements of any of the Implementing Agencies.

All information presented in this document is intended to be consistent with the Settlement. To the extent that inconsistencies exist, the Settlement should be the controlling document, and the information in this report will be revised prior to its inclusion in future documents. While the SJRRP Team is not requesting formal comments on this document, all comments received will be considered in refining the concepts and approaches described herein to the extent possible. Responses to comments on this report will not be provided; however, refinements will likely be reflected in subsequent SJRRP documents.

American White Pelicans photo by Lee Eastman

Table of Contents

Tables

Figures

List of Abbreviations and Acronyms

CEQA	California Environmental Quality Act
cfs	cubic feet per second
CVP	Central Valley Project
CalEPA	California Environmental Protection Agency
DFG	California Department of Fish and Game
DWR	California Department of Water Resources
FWUA	Friant Water Users Authority
IPAR	Initial Program Alternatives Report
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NRDC	Natural Resources Defense Council
PAR	Program Alternatives Report
PEIS/R	Program Environmental Impact Statement and Program Environmental Impact Report
Reclamation	U.S. Department of the Interior, Bureau of Reclamation
REST	Designation for initial restoration alternatives
RWA	Recovered Water Account
Settlement	*Natural Resources Defense Council et al. v. Kirk Rodgers et al*. Stipulation of Settlement
SJRRP	San Joaquin River Restoration Program
State	State of California
SWP	State Water Project
SWRCB	State Water Resources Control Board
The Reclamation Board	The Reclamation Board of the State of California
USFWS	U.S. Fish and Wildlife Service
WM	Designation for initial water management alternatives

Introduction

In 1988, a coalition of environmental groups, led by the Natural Resources Defense Council (NRDC), filed a lawsuit challenging the renewal of long-term water service contracts between the United States and the Central Valley Project (CVP) Friant Division contractors. After more than 18 years of litigation of this lawsuit, known as *NRDC et al. v. Kirk Rodgers et al.*, a Stipulation of Settlement (Settlement) was reached. On September 13, 2006, the Settling Parties, including NRDC, Friant Water Users Authority (FWUA), and the U.S. Departments of the Interior and Commerce, agreed on the terms and conditions of the Settlement, which was subsequently approved by the U.S. Eastern District Court of California on October 23, 2006.

The Settlement states that the Secretary of the Interior will implement the terms and conditions of the Settlement. The Settling Parties also agreed that implementation of the Settlement will require participation of the State of California (State). Concurrent with the execution of the Settlement, the Settling Parties entered into a Memorandum of Understanding (MOU) with the State of California by and through the California Resources Agency, the Department of Water Resources (DWR), the Department of Fish and Game (DFG), and the California Environmental Protection Agency regarding the State's role in the implementation of the Settlement. The program established to implement the Settlement is called the San Joaquin River Restoration Program (SJRRP). Implementing agencies responsible for the management of the SJRRP include United States Bureau of Reclamation (Reclamation), United States Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), DWR, and DFG.

Implementing Agencies

Bureau of Reclamation (Reclamation)
Fish and Wildlife Service (USFWS)
National Marine Fisheries Service (NMFS)
California Department of Water Resources (DWR)
California Department of Fish and Game (DFG)

The SJRRP is a comprehensive long-term effort to restore flows in the San Joaquin River from Friant Dam to the confluence of the Merced River, restore self-sustaining populations of salmon and other fish in the river downstream from Friant Dam, and provide replacement water supplies to long-term Friant Division water users subject to reduced deliveries as a result of the Settlement. The SJRRP includes many separate actions and projects that will be implemented over a multiple-year period. At this time, the specific details of many projects and actions cannot be determined, as many details will be developed using information to be collected early in the implementation period. The Program Environmental Impact Statement/Environmental Impact Report (PEIS/R) will consider implementation of the SJRRP as a whole, and thereby assemble and analyze the broadest range of direct, indirect, and cumulative impacts associated with the entire SJRRP rather than presenting detailed analyses of individual projects and actions. Site-specific projects, when implemented, are expected to tier from the PEIS/R, so that their evaluations can focus on detailed site-specific, rather than system-level, environmental effects. Accordingly, the PEIS/R must present a range of reasonable alternatives that can achieve SJRRP goals and foster informed decision-making and public participation. Preparation of the PEIS/R document will integrate compliance with NEPA, CEQA, and Section 404(b)(1) of the Clean Water Act.

Alternatives in the PEIS/R will address the SJRRP purpose and need through both the Restoration Goal and Water Management Goal, as specified in the Settlement:

- **Restoration Goal** – To restore and maintain fish populations in "good condition" in the mainstem San Joaquin River below Friant Dam to the confluence with 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 to all of the Friant Division long-term contractors that may result from the Interim Flows and Restoration Flows provided for in the Settlement.

PURPOSE OF THIS REPORT

This Initial Alternatives Formulation Report (IPAR) presents initial program alternatives as a starting point to formulate a range of approaches that achieve the SJRRP goals independently. These approaches will be evaluated and combined to program alternatives that meet both Settlement goals.

Technical work and continued coordination with landowners and other stakeholders over the next several months will increase understanding of how the initial alternatives may function. Continued inclusion of landowners and other stakeholders in the evaluation and refinement of these initial alternatives is expected to result in alternatives being dropped from further consideration, or others being added. In fact, none of the initial alternatives presented in this report are likely to be carried through the PEIS/R unchanged

IMPLEMENTATION SCHEDULE

The Settlement includes a timeline with specified dates for initiating Interim and Restoration Flows, completing construction of specified projects, and re-introduction of Chinook salmon to the San Joaquin River. The Implementing Agencies reviewed the Settlement schedule and included additional detail on interim documents during preparation of the PEIS/R, and environmental review documents for Phase 1 projects. As shown in Figure 1, the SJRRP schedule identifies several activities that will be undertaken concurrently.

Shortly after Court acceptance of the Settlement, the Implementing Agencies prepared a Program Management Plan in early 2007 to guide the SJRRP management structure and its coordination with Settling Parties and interested stakeholders. PEIS/R actions were initiated in fall 2007, with issuance a Notice of Intent (Federal) and Notice of Preparation (State of California) documents and public scoping meetings were held. The PEIS/R will be developed through a series of milestone documents, including this Initial Program Alternatives Report (IPAR), a Program Alternatives Report (PAR) and Draft and Final PEIS/R documents.

During preparation of the PEIS/R, the SJRRP will begin planning and permitting of Phase 1 and Phase 2 projects identified in the Settlement. Phase 1 projects identified in the Settlement include the highest priority channel and facility modifications to provide flow conveyance and fish passage. Phase 2 projects, also identified as high priority in the Settlement, will rely in part on information to be developed during the Interim Flow period. The Interim Flows include water released from Friant Dam in accordance with the Restoration Flow schedule identified in Exhibit B of the Settlement commencing no later than October 1, 2009, and continuing until full Restoration Flows begin. The purpose of the Interim Flows is to collect relevant data concerning flows, temperatures, fish needs, seepage losses, recirculation, recapture, and reuse. Interim Flows will not impede construction or exceed existing channel capacity. Concurrently, the SJRRP will plan and coordinate the implementation of projects toward achieving the Water Management Goal.

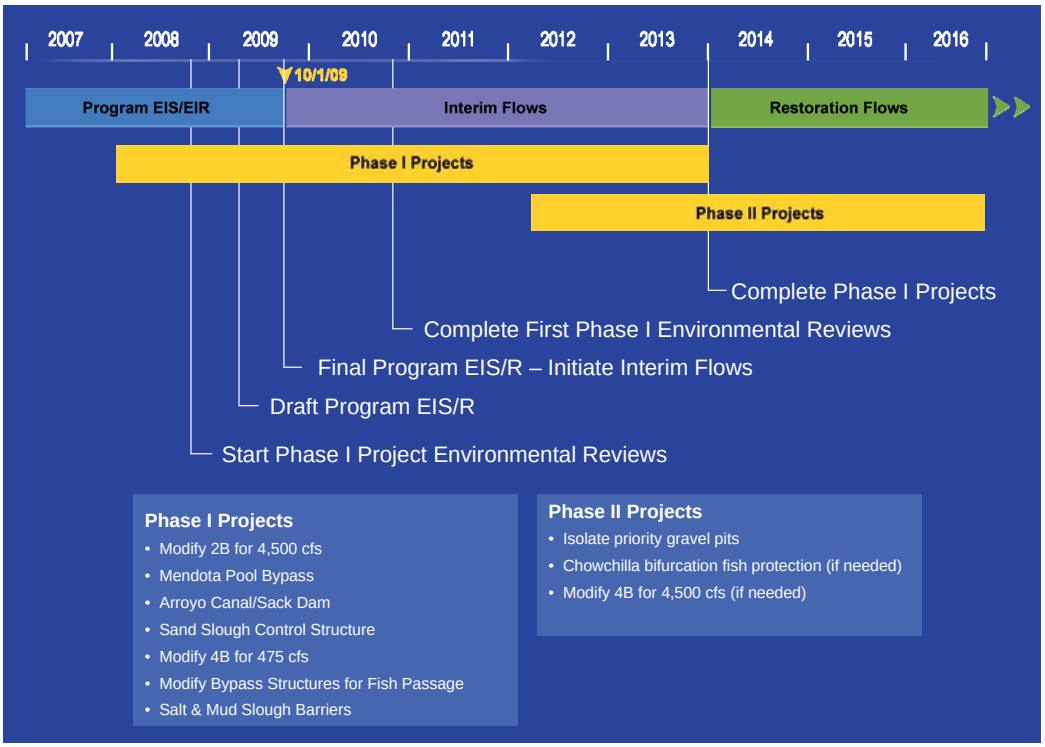


Figure 1
San Joaquin River Restoration Program Implementation Timeline

The schedule of major milestones agreed to in the Settlement assumes that funding and resources, timely availability of detailed information and survey results for environmental analyses, and cooperation by other Federal, state, and local agencies and landowners and the general public would not be limiting factors to implementation of SJRRP recommendations. Additional assumptions made during development of the implementation schedule relate to real estate, engineering and design, and construction.

Alternatives Formulation Strategy

The PEIS/R will evaluate a set of alternatives for achieving both the Restoration and Water Management Goals described in the Settlement. Each alternative is expected to include flow management strategies; identify specific projects to provide flow capacity, fish protection, and flood management improvements; describe water management projects, and include an implementation schedule. Given the numerous potential individual actions that could be assembled to form alternatives, a systematic methodology was developed to guide formulation of a range of reasonable alternatives for analysis in the PEIS/R.

The formulation of the final alternatives will be the result of a four-step methodology led by the Implementing Agencies in coordination with Settling Parties, other stakeholders, and interested members of the public. The four steps include:

1. Define SJRRP purpose and scope
2. Formulate initial program alternatives
3. Evaluate initial program alternatives and formulate combined program alternatives
4. Evaluate final program alternatives

The alternatives formulation approach began with identifying the purpose, need, and objectives of the SJRRP; developing planning constraints and assumptions; identifying a study area; and developing screening criteria and an approach (Step 1). These activities in turn helped narrow the potential range of alternatives. For example, the PEIS/R will evaluate alternative approaches to implement the provisions of the Settlement, but will not evaluate alternatives to the Settlement other than the required No-Action Alternative. Step 1 is complete, and the results are summarized in this section.

Step 2 is the formulation of initial program alternatives. It involves identifying themes for restoration and water management alternatives; identifying options; conducting first-stage screening of these options; and combining the remaining options into alternatives for each goal. An option is any structural or nonstructural action or feature that could help address the planning objectives and satisfy the other planning considerations. The results of this step are presented as initial restoration alternatives and initial water management alternatives in this IPAR.

Step 3 will include evaluation of the initial program alternatives and formulation of program alternatives. A Program Alternatives Report (PAR) will present the results of Step 3. The result of the first three steps will be a short list of final alternatives (likely three to five) for detailed evaluation in the PEIS/R. Step 4, the final iteration of evaluation and screening of alternatives, is accomplished in the Draft and Final PEIS/R.

The combined alternatives to be presented in the PEIS/R will include many separate options that would be implemented at different times. For example, features such as flow path, habitat restoration projects by reach and magnitude, channel capacity and levee modifications, approaches to water or vegetation management, and alternative ways to convey, store, conserve, and transfer water to meet the Water Management Goal will be grouped differently to formulate combined alternatives. Each grouping of these options comprises a distinct combined alternative for meeting the goals of the SJRRP.

The initial program alternatives presented in this report represent a starting point for defining combined alternatives to meet either the Restoration Goal or the Water Management Goal. These initial program alternatives are presented as concepts that will be reviewed, evaluated, and refined to more fully define the combined alternatives. Institutional actions and other options, such as recreation, will be considered and may be added to alternatives as they are refined in the coming months. Most importantly, the preferred alternative for implementation of the SJRRP is expected to rely on an adaptive management philosophy. Accordingly, adaptive management approaches will be selected based on the configuration of each alternative. The remaining sections of this chapter describe the implementation of Steps 1 and 2. The results of these steps, initial alternatives for meeting the Restoration and Water Management goals, are presented in chapters 3 and 4, respectively.

STEP 1 – DEFINE SJRRP PURPOSE AND SCOPE

Defining the SJRRP purpose and scope is the first step in formulating initial program alternatives. This includes identifying the purpose, need, and objectives of the SJRRP; developing planning criteria, constraints, and assumptions; and identifying a study area. These elements helped to narrow the potential range of alternatives and focus on what the Implementing Agencies want to achieve.

Purpose, Need, and Objectives

The purpose of the SJRRP is to implement the Settlement by meeting the Restoration Goal and Water Management Goal. The need for action arises from the historic operation of Friant Dam and the corresponding impacts on fisheries downstream; the potential adverse water supply impacts resulting from the release of Restoration Flows; and, from a legal perspective, the need for action in response to the Settlement. The SJRRP Team identified several objectives that need to be met to successfully achieve the two SJRRP goals:

- Improve channel capacity, fish habitat, related flood protection, fish passage, and fish screening.
- Release flows from Friant Dam to create conditions conducive to restoration.
- Reintroduce spring-run and fall-run Chinook salmon to the San Joaquin River below Friant Dam.
- Develop and implement a plan to recirculate, recapture, reuse, exchange, or transfer water released for Restoration Flows consistent with certain criteria identified in the Settlement.
- Establish a Recovered Water Account (RWA) that provides an opportunity to make water available to Friant Division long-term contractors with water supply reductions as a direct result of Interim Flows or Restoration Flows.
- Employ an adaptive management strategy that determines the best means for effectively and efficiently achieving the goals and objectives of the SJRRP.

Study Area

The Study Area for the PEIS/R encompasses areas that may be affected either directly or indirectly by implementation of actions included in the PEIS/R alternatives. The Study Area consists of three general geographic subareas: the San Joaquin River, the Sacramento-San Joaquin Delta (Delta), and the affected water service areas (including Federal, State, and local water service entities). Each of these geographic areas has the potential to be affected directly by implementation of SJRRP alternatives through construction and/or operational changes or indirectly through biological interactions and/or changes in water project operations. The San Joaquin River from Friant Dam to the Merced River confluence is the focus of SJRRP activities to achieve the Restoration Goal. The San Joaquin River reaches and associated bypass system that are referred to during alternatives development are shown in Figures 2 and 3 and identified in Table 1.

Table 1
San Joaquin River Reaches and Flood Bypasses From Friant Dam to the Merced River

Reach or Bypass	Head of Reach or Bypass	Downstream End of Reach or Bypass
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 the 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	Confluence with Ash Slough and Chowchilla Bypass	Confluence with Bear Creek and Eastside Bypass
Sand Slough Bypass	Sand Slough Control Structure	Eastside Bypass
Mariposa Bypass	Eastside Bypass east of Reach 4B1	Confluence with San Joaquin River

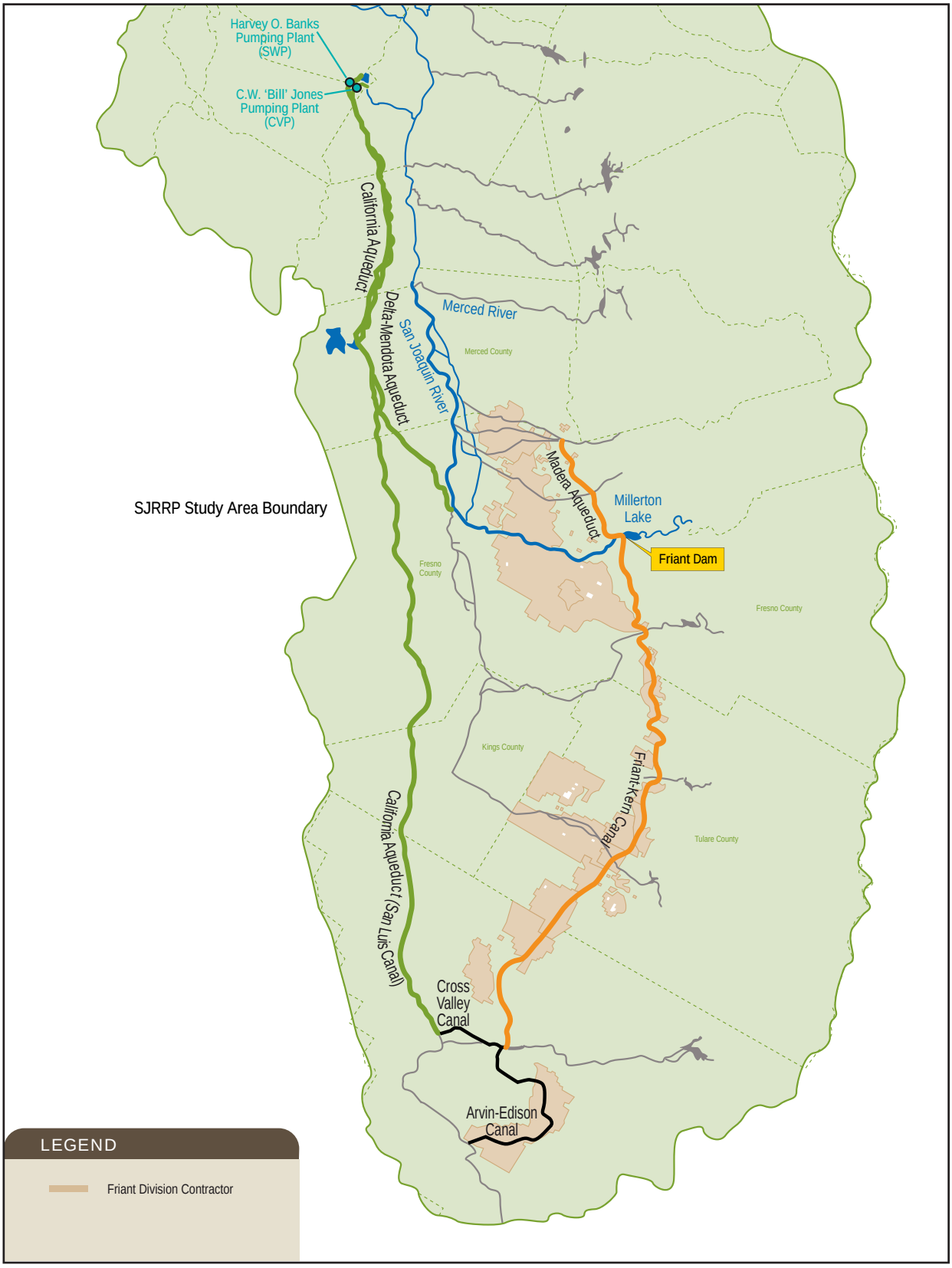


Figure 2
Area Where Physical Actions of the Initial Program Alternatives Occur

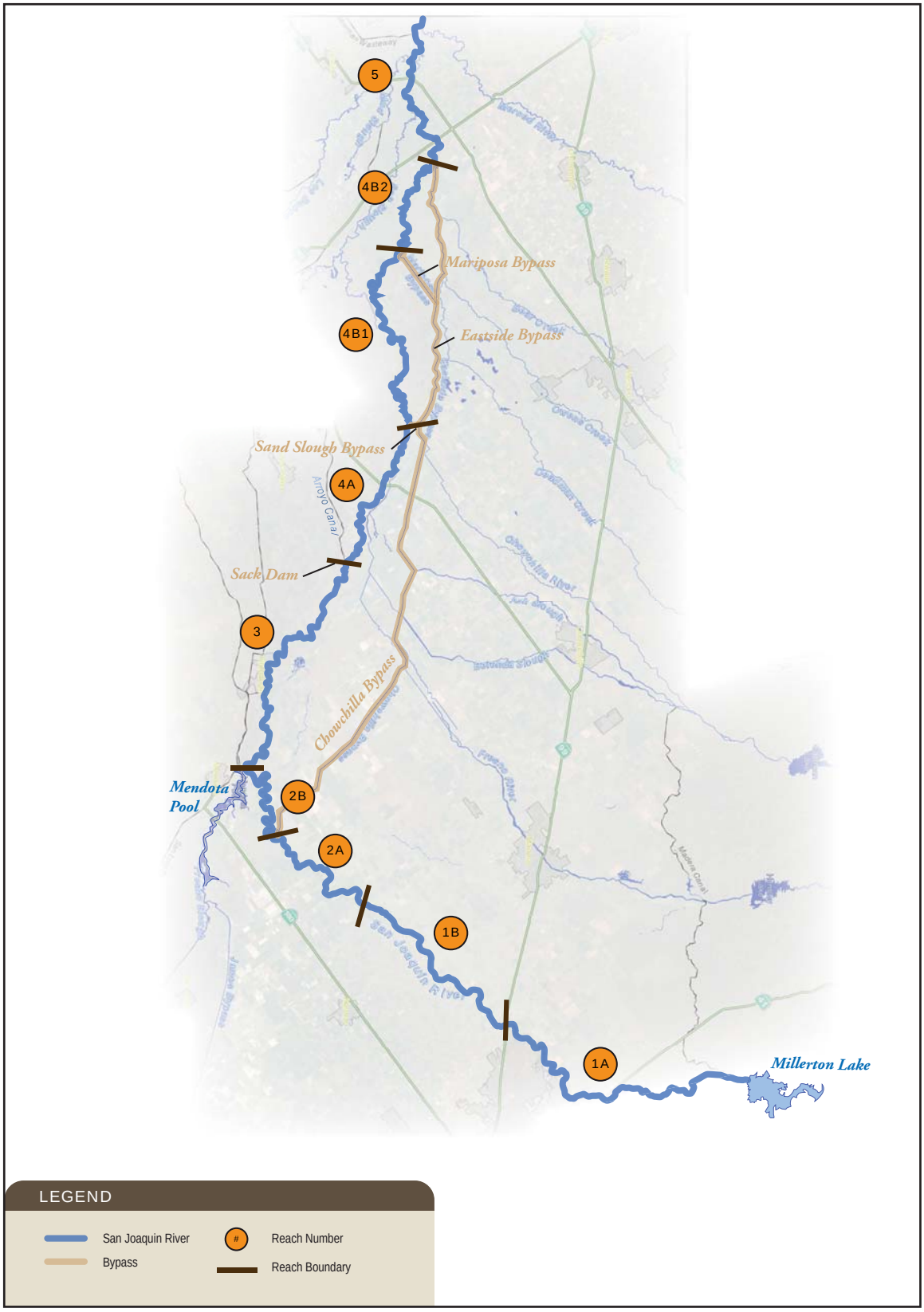


Figure 3
Schematic of Five San Joaquin River Reaches and Bypass System

Planning Constraints, Criteria, and Assumptions

The Settlement provides the basic framework for the actions to be taken during SJRRP implementation which serve as additional constraints, criteria, and assumptions for alternatives formulation. Many of the constraints, criteria, and assumptions to be considered during the alternatives formulation process for the PEIS/R identified in the Settlement are listed in Table 2.

Table 2
Restoration and Water Management Considerations in Key Settlement Paragraphs

Settlement Paragraph	Description of Considerations
11	Identifies specific channel and structural improvements considered necessary for achievement of the Restoration Goal. Includes a reach-by-reach list of improvements.
12	Acknowledges that additional channel or structural improvements not identified in paragraph 11 will likely be needed to achieve the Restoration Goal.
13	Identifies specific volumes of water releases from Friant Dam for different year-types (critically low to wet, as specified in the Settlement) as well as provisional water supplies to meet the Restoration Goal.
14	Calls for reintroducing spring-run and fall-run Chinook salmon between Friant Dam and the confluence with the Merced River by December 31, 2012, assigning priority to wild spring-run Chinook salmon over fall-run Chinook salmon if mutually incompatible.
15	Calls for beginning Interim Flows no later than October 1, 2009, and continuing until full Restoration Flows begin.
16	Requires development of a broad plan for recirculation, recapture, reuse, exchange, or transfer of the Interim Flows and Restoration Flows to reduce or avoid impacts to water deliveries for all Friant Division long-term contractors. This paragraph also calls for development of an RWA and program to make water available to the Friant Division long-term contractors who provide water to meet Interim Flows or Restoration Flows.
20	Calls for maintaining the Restoration Flows unless they are augmented by water acquisitions from willing sellers, by written agreement, or a final recommendation of the State Water Resources Control Board and a final Order of the Court.

Additional information to guide constraints, criteria, and assumptions are provided in prior and ongoing studies, and input from the Implementing Agencies, stakeholders, and the interested public. Many specific issues identified during the public scoping comment period that highlight additional constraints and assumptions of alternatives formulation include:

- **Restricted channel capacity** – Portions of the San Joaquin River do not currently have channel capacity to carry the anticipated Restoration Flows.
- **River seepage** – Some river reaches have historically been prone to seepage to adjacent fields under flows at or less than the Restoration Flows.
- **Flood management** – Flood management protection is a primary authorized purpose of Friant Dam and the San Joaquin River, and bypasses, provide flood protection to adjacent lands. Modifications to the flood management system to support restoration must not compromise flood management.
- **Irrigation flows** – Portions of the San Joaquin River function as conveyance for irrigation flows.
- **Invasive plant species** – Areas of the riparian ecosystem are degraded by infestations of nonnative invasive plants that have the potential to compromise or significantly reduce the effectiveness of successful implementation of restoration actions.

- **Restoration Flows** – The Settlement allows for acquiring additional water from willing sellers if needed to augment Restoration Flows. Water required beyond the flow schedules shall not increase water delivery reductions to any Friant Diversion long-term contractors.

STEP 2 – FORMULATE INITIAL PROGRAM ALTERNATIVES

Once the purpose and scope of the SJRRP was fully characterized as described above, initial program alternatives formulation began. This step involves identifying options and conducting first-stage screening of these options; identifying themes for restoration and water management alternatives; and combining the remaining options into alternatives for each goal.

Options Identification

More than 100 options were identified from various sources to enhance the success of the Restoration Goal or Water Management Goal. Sources used to identify specific options to achieve the goals include the Settlement, previous and ongoing studies, input from the Implementing Agencies, stakeholders, and the interested public, and the professional judgment of the SJRRP Team. These options include structural and nonstructural actions and features to address the planning objectives and satisfy the other planning considerations.

Screening Criteria and Approach

In consideration of the purpose, need, objectives, Study Area, constraints, and assumptions described above, a set of initial screening criteria were developed:

- **Program purpose** – Options that would not meet, or substantially contribute to meeting, the SJRRP purpose of implementing the Settlement, and meeting Restoration and/or Water Management goals and objectives will be eliminated from further consideration.
- **Technical feasibility** – Options that would not be technically feasible because of engineering or biological issues will be eliminated from further consideration. Engineering issues could include constructability problems, geotechnical constraints, excessive sedimentation, or other technical issues that make an option infeasible. Biological issues could include lack of physical or biological conditions to support certain life stages of the fish, or other water quality limitations. Also, questionable or untested technologies – or unreliable availability of resources – could make an option infeasible.
- **Environmental acceptability** – Options that create would unacceptable environmental impacts will be eliminated from further consideration. These may include options that would cause large impacts on endangered species or result in environmental conditions that are incompatible with restoration of the river.
- **Program scope** – Options that would require, or unduly depend on, large regional actions by others will be eliminated from further consideration. These could include regional or statewide actions designed for other purposes beyond the SJRRP that would require coordinated action by agencies not participating in the SJRRP.
- **Cost** – Options that could not be effectively implemented and maintained over time because of excessive capital costs or ongoing annual costs will be eliminated from further consideration. This could include eliminating one of two functionally equivalent options based on higher or comparable costs of one option.

The approach to complete screening is focused on the SJRRP goals and occurs in several stages to ensure that both SJRRP goals are met and that alternatives are complete, practicable, and feasible. Application of several stages of screening criteria allows selection of the most promising options and alternatives for meeting the SJRRP goals. Only first-stage options screening is performed in this report, as part of Step 2 of the alternatives formulation approach.

First-stage options screening applied the screening criteria to the options list to remove options identified as impracticable or infeasible for implementation in the initial alternatives. Several options were eliminated from further consideration because they did not meet one or more of the screening criteria. Those options remaining for consideration after the first stage of screening were combined into initial program alternatives under the themes to meet each of the SJRRP goals.

Themes for Restoration and Water Management Alternatives

To begin assembling initial program alternatives, the SJRRP Team considered an overall approach, or theme, to guide which options should be included with each initial alternative. The themes were identified to represent the range of alternatives possible for achieving the Restoration and Water Management goals, while resulting in distinct alternatives. Restoration Goal themes focused on different ecological approaches, while Water Management Goal themes focused on using existing or new local or regional conveyance and storage facilities. These themes provided the basis for the alternatives presented in the following chapters.

Initial Restoration Alternatives

This section presents the formulation of initial restoration alternatives. Each initial restoration alternative includes a combination of options with the common objective of meeting the Restoration Goal. Initial restoration alternatives will be evaluated and reconfigured before being combined with initial water management alternatives into a set of combined alternatives for evaluation in the PEIS/R.

CONSIDERATIONS FOR DEVELOPING RESTORATION ALTERNATIVES

Restoration of the San Joaquin River will require numerous actions before full Restoration Flows begin and salmon are reintroduced. Meeting the Restoration Goal is a multi-faceted challenge, particularly in light of a river that has not supported salmon for more than six decades, and a river corridor that has been significantly altered since construction of Friant Dam. When identified, the preferred alternative will include a set of initial projects and making management activities that are essential to begin restoration. The preferred alternative will further establish a decision process that allows incremental changes as additional information becomes available. This adaptive management approach will allow uncertainties to be addressed as the river responds to restoration actions.

Adaptive Management

Adaptive management strategies will allow SJRRP goals to be achieved while providing flexibility to adjust actions as decision-makers learn more about system responses. A monitoring program will help natural resource managers evaluate program successes, and address key uncertainties. General adaptive management protocols include:

- *Monitor and model the system in terms of current understanding about system dynamics, based on sound science.*
- *Design management actions to maximize conservation and information benefits.*
- *Implement actions with a cautious experimental approach, and monitor the system response.*
- *Update alternative hypotheses, and adjust management actions, as appropriate.*
- *Design new projects and management actions based on improved understanding of the river system.*

RANGE OF PROGRAM ACTIONS

Many physical, biological, and management actions that can affect the success of restoration must be considered at a system level. In the development of initial restoration alternatives, numerous options were defined that would address one or more actions. Some options were defined as reach- or site-specific, whereas others reflect system-wide actions. Although all actions are important to the restoration, and ultimately defining alternatives, many are best determined once the basic structure of an alternative is defined. For instance, many management activities, such as control of invasive plants and animals, can be added to each of the alternatives, as needed, but likely would not differentiate one alternative from another.

Actions Affecting Restoration Success

- *Channel capacity and configuration*
- *Flow management*
- *Fish introduction*
- *Fish passage*
- *Invasive species management*
- *Sedimentation management*
- *Habitat restoration and management*
- *Vegetation management*
- *Fish entrainment*
- *Temperature management*
- *Toxics control*

Two principal issues must ultimately be resolved to help guide the formulation of initial restoration alternatives:

- Fish Habitat Locations. This issue addresses locations in the river system where fish could be expected to migrate, hold, spawn, and rear. Examination of this issue helped define a range of potential channel modifications, floodplain reconfiguration, and habitat establishment in each reach.
- Flow paths and Capacities in Reach 4B and Flood Bypasses. The ultimate capacity of Reach 4B determines the remaining Restoration Flow, if any, that would pass through the Eastside and Mariposa bypasses. Similarly, if the Chowchilla Bypass is used for Restoration Flows, then levee and channel along the river would be less, but additional modifications may be needed in the bypasses to assure continued performance of the flood management system.

In formulating initial restoration alternatives, many actions could only be defined once these issues were addressed and the general structure of the river system was defined. For example, once the area for fish rearing and the flow path were defined, other actions could be added to provide greater definition of an alternative. To assist in this process, specific restoration options were organized based on the degree to which they would help accomplish an action, as summarized in Table 3.

SUMMARY OF INITIAL RESTORATION ALTERNATIVES

Eight initial restoration alternatives were developed that cover a wide range of potential ways of achieving the Restoration Goal, as listed in Table 4. A thematic approach was used to guide which options would be included in each initial restoration alternative. Formulation of initial restoration alternatives began by including provisions of Paragraph 11 of the Settlement, which identifies several specific channel capacity, flow control, and fish passage modifications. Paragraph 11 calls for modifications to 4B during Phase 1 to pass at least 475 cfs and additional increase up to 4,500 cfs during Phase 2, unless it is determined that such modification would not substantially enhance achievement of the restoration goal. Three restoration alternatives cover a range of flow possibilities bounded by these endpoints. Four more alternatives generally build on the first three by including additional restoration actions that may be necessary to achieve the Restoration Goal – but are not explicitly specified by – Paragraph 12 of the Settlement. Lastly, one alternative, based on existing river and bypass capacity, was developed to provide insight regarding the incremental modifications expected during the Interim Flow period.

Initial Restoration Alternatives

- *Three initial restoration alternatives are based on covering the range of actions specified in Paragraph 11 of the Settlement.*
- *Four alternatives generally build on the first three by including additional restoration actions allowed, but not specified, by Paragraph 12 of the Settlement.*
- *One alternative, based on existing river and bypass capacity, was developed to provide insight regarding the incremental modifications expected during the interim Flow period.*

Table 3
Restoration Options to Implement Program Actions Varying Levels

Action	Representative Options at Varying Levels of Implementation		
	Low	Intermediate	High
Spawning riffles	Augment existing riffles	No intermediate action identified	Create and maintain new riffles
Temperature control structures at Friant Dam	No action	Install a temperature control device on the San Joaquin River outlet	Install temperature control devices on the San Joaquin River, Madera Canal, and Friant-Kern Canal outlets
Restoration flows	No range considered in the Initial Alternatives		
Manage/monitor invasive plants	No management	Manage selected species in selected reaches	Manage numerous species in all reaches
Manage/monitor invasive animals	No management	Manage selected species in selected reaches	Manage numerous species in all reaches
Manage growth of channel and floodway vegetation	No management	Management in some reaches	Management in all reaches
Reintroduce salmon	Initial reintroduction	No intermediate action identified	Supplemental reintroductions as needed (as after critical low years)
Isolate gravel pits in Reach 1	No isolation of gravel pits	Isolation of highest priority pits	Isolation of all pits
Install fish passage and flow control structures	Minimal installation of structures	Moderate installation of structures	Extensive installation of structures
Plant supplemental vegetation	Use Restoration Flows only to enhance revegetation	Use Restoration Flows and minimal planting to enhance revegetation	Use Restoration Flows and planting to enhance revegetation
Establish low-flow channel in Reach 2A	Rely on natural processes	Use minimal revetment and vegetation to establish and maintain channels	Use extensive revetment and vegetation to establish and maintain channels
Reconfigure floodplain in Reach 2B	Resolve seepage and levee issues	Reconfigure floodplain, side channels and habitat	Construct new levees and reconfigure floodplain, side channels and habitat
Construct Mendota Pool Bypass	Construct Mendota Pool Bypass to convey 1,300 cfs	No intermediate action identified	Construct Mendota Pool Bypass to convey 4,500 cfs
Modify levees in Reach 3	No action	No intermediate action identified	Modify levees to convey 4,500 cfs
Improve Reach 4B capacity	No Action	Modify Reach 4B to convey 475 cfs with some channel work, or 2,500 cfs with channel work and new levees	Modify Reach 4B to convey 4,500 cfs with channel work, new levees, floodplain reconfiguration. and revegetation
Obtain grazing easements	No action	No intermediate action identified	Obtain grazing easements for reaches 4B2 and 5
Establish low-flow channels in the bypasses	No action	No intermediate action identified	Resolve seepage and levee issues

Key:
cfs = cubic feet per second

To help assess the division of flow between the river and the bypass system, two initial restoration alternatives consider less intensive river channel/floodplain work in Reach 2B. This approach was chosen to support a comparison of dual conveyance paths (river and Chowchilla Bypass) to achieve the Restoration Goal to one flow path.

The relative emphasis of physical actions that distinguish initial restoration alternatives are reflected by three aspects listed in Table 5. These include the maximum capacity through Reach 4B, the use of the Chowchilla Bypass for Restoration Flows, and the extent of channel and floodplain modification that would be implemented in each reach. The degree of emphasis was used to help select specific options from Table 3-2 to develop more complete alternatives descriptions. Specific features included in initial restoration alternatives are listed in Table 6.

Table 4
Initial Restoration Alternatives

Name	Purpose
Initial Alternative REST 1	This alternative includes Paragraph 11 actions with channel improvements within Reach 4B1 to carry 475 cfs.
Initial Alternative REST 2	This alternative includes Paragraph 11 actions with new levees and channel improvements within Reach 4B1 to carry 2,500 cfs. This capacity was selected as an evaluation mid-point between 475 cfs and 4,500 cfs,, and carries no other significance.
Initial Alternative REST 3	This alternative includes Paragraph 11 actions with new levees, channel improvements, and floodplain reconfiguration within Reach 4B1 to carry 4,500 cfs.
Initial Alternative REST 4	This alternative would optimize habitat in Reach 1A and use the remainder of the river reaches principally for fish transport.
Initial Alternative REST 5	This alternative would optimize habitat in Reach 1 and Reach 2.
Initial Alternative REST 6	This alternative provides for salmon rearing in all reaches of the river.
Initial Alternative REST 7	This alternative provides a riparian corridor to support fish restoration along all reaches of the river.
Initial Alternative REST 8	This alternative would maximize the use of existing channel capacity, with only strategic enlargements. It was formulated, in part, to assess possible conditions that will occur during the Interim Flow period.

Key:
cfs = cubic feet per second

Table 5
Broad Summary of Initial Restoration Alternatives

General Attributes		Initial Restoration Alternatives							
		Settlement-Based[1] (low flow to Reach 4B1)	Settlement-Based[1] (medium Flow to Reach 4B1)	Settlement-Based[1] (high flow to Reach 4B1)	Fish Transport (optimize Reach 1A habitat)	Strategic Salmon Rearing (optimize Reaches 1 & 2 habitat)	Full River Salmon Rearing (provide for salmon rearing in all reaches)	Riparian Corridor (river riparian corridor for fish)	Strategic Channel Capacity (use existing channel capacity to extent possible)
Initial Restoration Alternative Number		REST 1	REST 2	REST 3	REST 4	REST 5	REST 6	REST 7	REST 8
Maximum Flow in Reach 4B1 (cubic feet per second)		475	2,500	4,500	475	475	4,500	2,500	0
Restoration Flow to Chowchilla Bypass (variable flows)		No	No	No	Yes	No	No	No	Yes
Restoration Flow to Eastside and Mariposa Bypasses (variable flows)		Yes	Yes	No	Yes	Yes	No	Yes	Yes
Extent of Channel Floodplain/ Habitat Work	Reach 1A	XX	XX	XX	XXX	XXX	XXX	XX	X
	Reach 1B	NA	NA	NA	NA	XXX	XXX	NA	NA
	Reach 2A	NA	NA	NA	X	X	X	X	X
	Reach 2B	XXX	XXX	XXX	XX	XXX	XXX	XXX	XX
	Reach 3	X	X	X	NA	X	X	X	NA
	Reach 4A	NA	NA	NA	NA	NA	NA	NA	NA
	Reach 4B	X	XX	XXX	X	X	XXX	XX	NA
	Reach 5	NA	NA	NA	NA	NA	NA	NA	NA
	Bypasses	X	X	X	X	X	NA	X	X

Key:
X = Minor XX = Moderate XXX = Major NA = No action
Notes:
[1] The first three initial restoration alternatives are based on covering the range of actions specified in Paragraph 11 of the Settlement. The remaining five alternatives generally build on these first three alternatives by adding additional restoration actions allowed, but not specified, by Paragraph 12 of the Settlement.

Table 6
Summary of Options Included in Initial Restoration Alternatives

Options	Restoration Alternative							
	REST 1	REST 2	REST 3	REST 4	REST 5	REST 6	REST 7	REST 8
System-wide								
Restoration flows	x	x	x	x	x	x	x	x
Temperature control for San Joaquin River outlet					x	x	x	
Temperature control device Friant-Kern Canal outlet						x		
Temperature control for Madera Canal outlet						x		
Screen small diversions				x	x	x	x	x
Manage/monitor invasive plants					x	x	x	
Manage channel and floodway vegetation				x	x	x	x	x
Manage/control invasive animals				x	x	x	x	x
Fish introduction (initial)	x	x	x	x	x	x	x	x
Fish introduction (supplemental/dry year)				x	x	x	x	x
Reach 1A								
Augment existing riffles	x	x	x	x	x	x	x	x
Establish and maintain new riffles				x	x	x	x	
Reconfigure channel/side channels				x	x	x	x	
Isolate high priority gravel pits	x	x	x				x	
Isolating all gravel pits/reconfigure floodplain				x	x	x		
Manage/monitor invasive plants				x				x
Reach 1B								
Isolate all gravel pits/ reconfigure floodplain					x	x		
Supplemental vegetation planting					x	x	x	
Reach 2A								
Modify Chowchilla BP for fish passage	x	x	x	x	x	x	x	
Modify low flow channel to carry 475 cfs				x	x	x	x	x
Reconfigure floodplain/side channels					x	x	x	
Supplemental vegetation planting					x	x	x	
Reach 2B								
4,500 cfs floodplain and riparian habitat	x	x	x		x	x	x	
Mendota pool BP (4,500 cfs) and bifurcation structure	x	x	x		x	x	x	
Mendota pool BP (1,300 cfs) and bifurcation structure				x				x
Supplemental vegetation planting					x	x	x	
Reach 3								
Modify levees to convey 4,500 cfs	x	x	x		x	x	x	
Screen Arroyo Canal	x	x	x	x	x	x	x	x
Fish passage at Sack Dam	x	x	x	x	x	x	x	x
Supplemental vegetation planting						x	x	
Reach 4A								
Fish passage at Sand Slough	x	x	x	x	x	x	x	
Supplemental vegetation planting						x	x	
Reach 4B1								
475 cfs plus headgate	x			x	x			
2,500 cfs plus headgate		x					x	
4,500 cfs plus headgate			x			x		
Supplemental vegetation planting						x	x	
Reach 4B2								
Grazing easements downstream from Mariposa BP						x	x	
Reach 5								
Provisions for barriers at Mud and Salt sloughs	x	x	x	x	x	x	x	x
Grazing easements						x	x	
Bypasses								
Modify structures in ESBP/MPBP for fish passage	x	x	x	x	x	x	x	x
Low flow channel in ESBP	x	x		x	x		x	x
Low flow channel in MP BP	x	x					x	x
Low flow channel in Chowchilla BP				x				x
Fish barrier at confluence ESBP & Sand Slough BP								
Fish barriers on ESBP tributaries				x	x		x	
Institutional								
To be determined in Program Alternatives Report								

Key: BP = bypass(es) cfs = cubic feet per second ESBP = Eastside Bypass MPBP = Mariposa Bypass

Initial Water Management Alternatives

Paragraph 16 of the Settlement addresses the Water Management Goal, which includes actions to reduce or avoid adverse water supply impacts to all of the Friant Division long-term contractors that may result from the Interim Flows and Restoration Flows provided for in the Settlement. It identifies two sources of water supplies that are available to help achieve the Water Management Goal. These include recirculation of Interim and Restoration Flows and delivery of surplus San Joaquin River water supplies available at Friant Dam. The Water Management Goal, therefore, is equal to the reduction in water deliveries to Friant Division long-term contractors resulting from implementation of the Restoration Goal. Preliminary evaluations have shown that this amount averages approximately 145 to 202 thousand acre-feet per year. Annual variations in water delivery impacts will vary, depending on hydrologic conditions and Restoration Flow guidelines. The SJRRP is developing Restoration Flow guidelines, including methods to forecast available supplies and transform flow schedules presented in Exhibit B of the Settlement.

Paragraph 16a directs the Secretary to develop and implement a plan for recirculation, recapture, reuse, exchange or transfer of the Interim Flows and Restoration Flows to Friant Division long-term contractors for the purpose of reducing or avoiding water supply impacts resulting from implementation of the Restoration Goal. These supplies would be recaptured from the San Joaquin River or the Delta and conveyed to the Friant Division using available capacity in the California Aqueduct or the Delta-Mendota Canal.

Paragraph 16b describes a Recovered Water Account (RWA) to monitor and record reductions in water deliveries to Friant Division long-term contractors occurring as a direct result of Interim Flows and Restoration Flows that have not been replaced by actions implemented pursuant to paragraph 16a or other projects. The Settlement further provides for delivery of surplus San Joaquin River flows, at a specified cost, to Friant Division long-term contractors who provide water to meet the Interim Flows and Restoration Flows. Surplus San Joaquin River flows captured as part of the RWA are referred to as *RWA supplies*.

In developing Water Management Goal alternatives, the SJRRP reviewed previous studies by various agencies and groups identified potential options that could be used to capture, transport, and store recirculated and RWA water supplies. Among others, these include a 2007 report prepared by FWUA describing potential water management projects. This information was supplemented with additional suggestions obtained through coordination with FWUA members to identify potential water management options for consideration during alternatives development.

CONSIDERATIONS FOR DEVELOPING WATER MANAGEMENT ALTERNATIVES

Achievement of the Water Management Goal could be constrained by a number of factors that may limit the quantity of flows that can be delivered to the Friant Division. These considerations can be grouped into categories based on their scope: (1) physical and structural limitations and (2) institutional and legal issues. Initial Water Management Alternatives are formulated to help identify the extent to which many of these factors affect the ability to implement the Paragraph 16a and 16b provisions of the Water Management Goal.

Physical and Structural Limitations

- *Availability of recirculation and RWA supplies*
- *Existing Conveyance Capacity*
- *Groundwater Recovery*
- *Lower San Joaquin River Water Quality*
- *Environmental Impacts*

Institutional and Legal Issues

- *Delta Pumping Constraints*
- *Transfer/Exchange/Banking Agreements*
- *Water Rights*
- *Financial Responsibility*

RANGE OF PROGRAM ACTIONS

Three principal variables are considered in the formulation of initial water management alternatives. These include the source of water, regional conveyance, and local conveyance and storage.

Water sources to support the Water Management Goal include recirculation of Interim and Restoration Flows (Paragraph 16a) and surplus San Joaquin River supplies at Friant Dam delivered pursuant to the RWA (Paragraph 16b). Regional conveyance includes large regional facilities, such as the Delta-Mendota, Friant-Kern and Madera canals, the California Aqueduct, and a potential new pumping plant on the San Joaquin River to capture Interim and Restoration Flows. Local conveyance and storage includes projects that would be implemented by individual or multiple water districts that increase the capability to receive, manage, and deliver water to water users in the Friant Division. Initial water management alternatives are formulated based on varying degrees of reliance on existing or new regional conveyance and/or local conveyance and storage projects.

Numerous physical water management options that could increase regional conveyance capacity, or increase local conveyance and storage capacity, were identified through coordination with FWUA. Water management options were organized based on whether they involve the use of existing structures or new structures, and on their purpose as regional conveyance, local conveyance, storage, or exchange opportunities to utilize recirculation or RWA supplies. Options that would increase regional conveyance capacity are specifically identified at varying levels of increased capacity. Options that would increase local conveyance or storage capacity were grouped based on their location in seven Water Management Areas in the Friant Division. The Water Management Areas were defined based on several factors, including regional conveyance capacity changes in the Friant-Kern Canal (FKC), delivery locations on the FKC, historic and current coordination among Friant Division contractors, access to groundwater basins, and other local factors.

Preliminary technical evaluations focused on identifying changes in conveyance or storage capacity and preparing pre-appraisal level cost estimates. Additional technical analyses are needed to reflect the operational effects of the options, and to differentiate their performance.

All initial Water Management Goal alternatives assume the use of both recirculation and RWA water supplies. They were formulated to reflect a range of implementation of both regional and local projects and should be viewed as general strategic plans for capturing and delivering water supplies to avoid or reduce adverse impacts to the Friant Division contractors. It is recognized that multiple redundant options for conveyance and storage exist within each alternative.

SUMMARY OF INITIAL WATER MANAGEMENT ALTERNATIVES

Eight initial water management alternatives reflect a range of implementation of regional and local projects, based on three main themes: (1) regional conveyance, (2) local conveyance and storage, and (3) the water source. The themes are distinguished based on the extent that new or expanded regional conveyance, local conveyance, and storage are included. All alternatives address both recirculation and RWA water supplies. A general description of each initial water management alternative is provided in Table 7.

Table 7
Initial Water Management Alternatives

Name	General Description
Initial Alternative WM1	Existing regional conveyance and existing local conveyance and storage would be used for the capture and storage of water management supplies.
Initial Alternative WM2	Existing regional conveyance and new local conveyance and storage would be used for the capture and storage of water management supplies.
Initial Alternative WM3	New regional conveyance would be used to capture recirculation supplies and existing regional conveyance would be used to capture RWA supplies. Existing local conveyance and storage would be used for water management supplies.
Initial Alternative WM4	Existing regional conveyance would be used to capture recirculation supplies and new regional conveyance would be used to capture RWA supplies. Existing local conveyance and storage would be used for water management supplies.
Initial Alternative WM5	New regional conveyance would be used to capture recirculation supplies and existing regional conveyance would be used to capture RWA supplies. New local conveyance and storage would be developed for water management supplies.
Initial Alternative WM6	Existing regional conveyance would be used to capture recirculation supplies and new regional conveyance would be used to capture RWA supplies. New local conveyance and storage would be developed for water management supplies.
Initial Alternative WM7	New regional conveyance and existing local conveyance and storage would be used for the capture and storage of water management supplies.
Initial Alternative WM8	New regional conveyance and new local conveyance and storage would be used for the capture and storage of water management supplies.

Key: cfs = cubic feet per second

The general descriptions were applied to the list of regional and local water management options to develop more detailed definitions of the initial water management alternatives, as presented in Table 8. General locations of regional conveyance features are shown in Figure 4, in relationship to the Water Management Areas.

Table 8
Summary of Initial Water Management Alternatives

Major Water Management Approach	Settlement-Based: Recapture, Recirculate, and Exchange Restoration Flows and Capture and Convey Surplus San Joaquin River Flows							
Water Management Alternatives	**WM1**	**WM2**	**WM3**	**WM4**	**WM5**	**WM6**	**WM7**	**WM8**
Possible Regional Conveyance								
Use Available Capacity of Jones and Banks Pumping Plants	■	■		■		■		
Use Available Capacity in Delta-Mendota Canal and California Aqueduct	■	■	■	■	■	■	■	■
Use Available Capacity in Madera Canal	■	■	■	■	■	■	■	■
Use available Capacity in Friant-Kern Canal	■	■	■		■			
New Regional Pumping Plant and Conveyance			■		■		■	■
New/Upgrade Capacity in Friant-Kern Canal				■		■	■	■
Possible Local Conveyance								
Use Available Capacity in Arvin-Edison Intertie	■	■	■	■	■	■	■	■
Use Available Capacity in Cross Valley Canal	■		■	■			■	
Upgrade Capacity in Cross Valley Canal		■			■	■		■
Construct Pump-Back Facilities		■	■		■	■		■
New Multidistrict Conveyance								
Construct Mid-Valley Canal		■			■	■		■
Construct Trans-Valley Canal		■			■	■		■
Construct Other Multi-District Conveyance		■			■	■		■
Possible Groundwater Banks and Storage[1]								
Use Available Capacity in Existing Groundwater Banks and Groundwater Storage Districts	■		■	■			■	
Use Available Capacity in Existing and New Groundwater Banks and Groundwater Storage Districts		■			■	■		■

Notes:
[1] Many groundwater banking and storage projects have been identified in the area. Further evaluations are required to identify specific projects for water management alternatives.

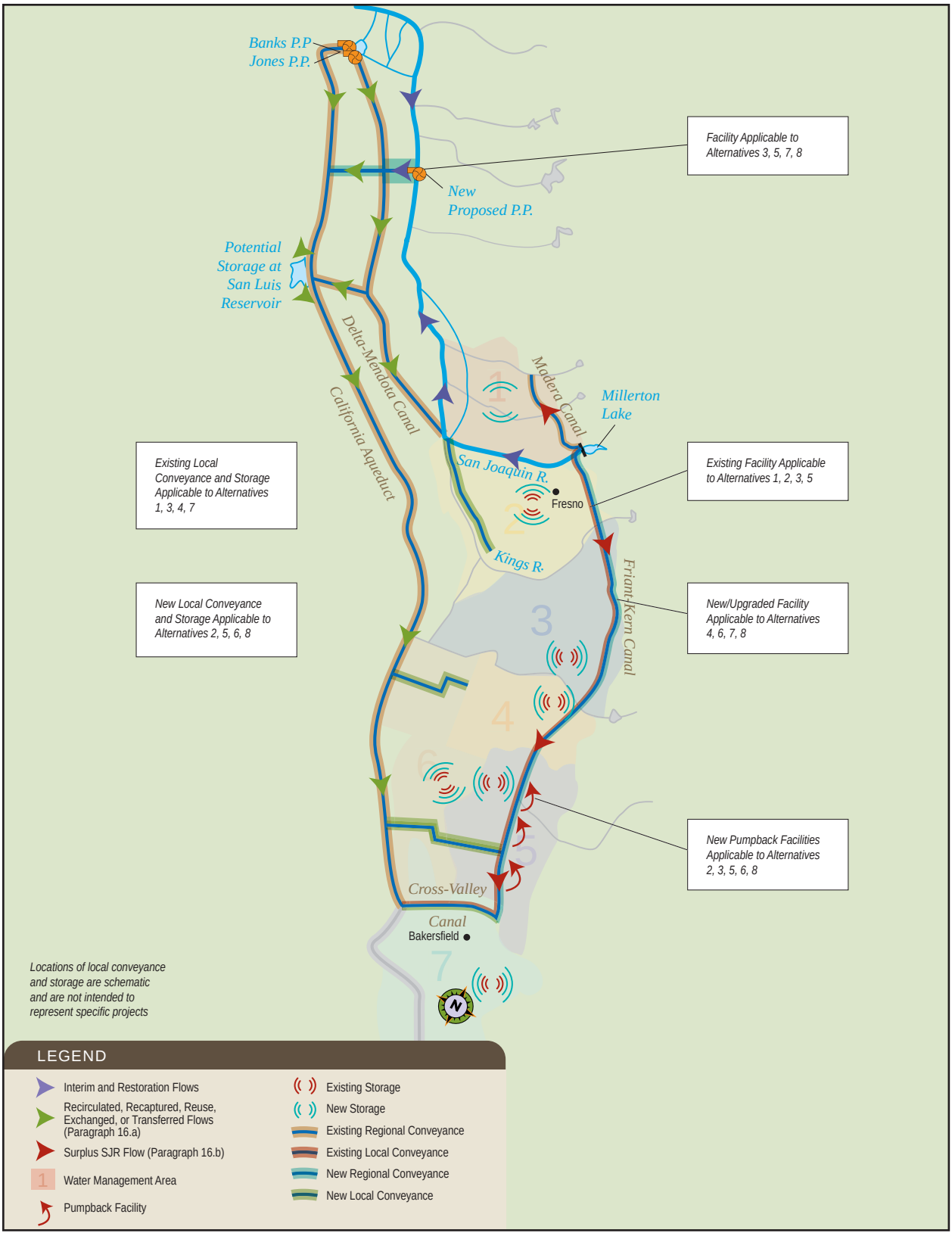


Figure 4
Locations of Water Management Conveyance and Storage Options

Next Steps

The initial program alternatives presented in this report are focused on either meeting the Restoration Goal or the Water Management Goal. Technical evaluations and ongoing coordination with landowners and other stakeholders over the next several months will increase understanding of how the initial alternatives may function, and provide important input to the formulation of combined program alternatives. During the next few months, initial program alternatives will be assessed using technical tools, previous studies, and professional judgment. Through this process, it is expected that options included in the initial program alternatives will be revised as necessary, and either dropped or combined into program alternatives for evaluation in the PEIS/R. A summary of program alternatives will be presented in the Program Alternatives Report, which is expected to be completed in October 2008.

The following sections describe the anticipated next steps in evaluating, refining, and combining features included in the initial restoration and water management alternatives into combined program alternatives.

NEXT STEPS FOR RESTORATION GOAL ALTERNATIVES

The evaluation of initial restoration alternatives will focus on the expected outcomes of each alternative in relation to achieving the Restoration Goal. Evaluations will be based on biological and ecological principles described in the Conceptual Model, and will be supplemented with sensitivity evaluations of specific technical issues. The Conceptual Model identifies critical environmental stressors for spring-run and fall-run Chinook salmon life stages and provides a framework for evaluating relative effects of physical, water management, and habitat management actions.

Evaluations of initial restoration alternatives will begin with assessments based on the Conceptual Model. The results of these evaluations will be used to develop more specific objectives for physical conditions in each river reach and population targets. Findings from these evaluations will be used to guide the formulation of combined alternatives to be presented in the PAR Evaluations of initial restoration alternatives will include, but may not be limited to, the following actions:

- Describe the expected effects of each initial restoration alternative on fish species by applying the Conceptual Model.
- Use results of initial alternatives assessments to develop reach-specific fish restoration objectives for application in combined program alternatives.
- Use results of initial alternatives assessments to develop population targets that will be used to guide the design of restoration options.
- Apply computational models and other technical tools to obtain additional information on the performance of initial restoration alternatives. Technical evaluations may include:
  - Water operations simulations to support flow transformation development and identify opportunities to combine actions that could mutually support the Restoration

and Water Management goals

- Hydraulic simulations of river stage, including effects of vegetation
- Two dimensional hydraulic simulations in key locations
- Sedimentation and scour
- River temperature
- Seepage
- Vegetative growth

- Refine appraisal-level assumptions and cost estimates, for options included in initial program alternatives.

Using results from the analyses stated above, the initial restoration alternatives will be evaluated and screened, and combined with the water management actions in program alternatives.

NEXT STEPS FOR WATER MANAGEMENT GOAL ALTERNATIVES

The initial water management alternatives in the IPAR are general in nature and include a large number of options, particularly those focused on local conveyance and storage. The next steps will focus on further differentiating regional actions from local actions and completing evaluations that identify the amount of water that could be provided to the Friant Division from both recirculation and surplus supplies. The water availability evaluations will begin with a focus on how changes to regional conveyance facilities would affect the availability of water supplies using existing and several different combinations of local conveyance and storage improvements. Technical studies of water supply availability and assumptions regarding changes to local conveyance and storage capacity will be coordinated with FWUA and Friant Division districts. This will be done to assure model representations portray implementable actions and that current and planned improvements are reflected.

Anticipated steps for refining the initial water management alternatives include the following actions:

- Apply numerical models to estimate how water supplies availability is affected by changes in regional and local conveyance.
- Through coordination with Friant Division districts, estimate the quantities and general performance characteristics of groundwater banks that may be considered for storage of water management supplies.
- Refine appraisal-level cost estimates for regional conveyance options included in the initial program alternatives.
- Examine the potential for transfer and/or exchange opportunities within and between the Water Management Areas and water sources.
- Identify opportunities to integrate Water Management Goal actions with Restoration Goal actions.

Using results from the analyses stated above, the water management options will be evaluated and screened, and combined with the restoration actions in program alternatives.

SAN JOAQUIN RIVER
RESTORATION PROGRAM