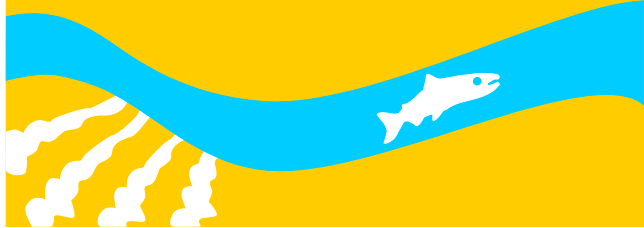


Public Draft

# 2013 Monitoring and Analysis Plan

**SAN JOAQUIN RIVER**  
RESTORATION PROGRAM



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**Public Draft**

# **2013 Monitoring and Analysis Plan**

Prepared for and in cooperation with the SJRRP by MWH.

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## Abbreviations and Acronyms

2D	two-dimensional
Act	San Joaquin River Restoration Settlement Act
ATR	Annual Technical Report
CDEC	California Data Exchange Center
cfs	cubic foot per second
DFG	California Department of Fish and Game
DO	dissolved oxygen
DWR	California Department of Water Resources
EA/IS	Environmental Assessment/Initial Study
EDT	Ecosystems Diagnosis and Treatment
EIS/R	Environmental Impact Statement/Report
Implementing Agencies	agencies responsible for implementing the Settlement
LiDAR	light detection and ranging
MAP	Monitoring and Analysis Plan
MMP	Monitoring and Management Plan
NMFS	National Marine Fisheries Services
NOAA	National Oceanic and Atmospheric Administration
PEIR	Program Environmental Impact Report
PEIS/R	Program Environmental Impact Statement/Report
PIT	passive integrated transponder
RA	Restoration Administrator
Reclamation	U.S. Department of the Interior, Bureau of Reclamation
RWA	Recovered Water Account
Settlement	Stipulation of Settlement in <i>NRDC, et al., v. Kirk Rodgers, et al.</i>
SJR	San Joaquin River
SJRRP	San Joaquin River Restoration Program
State	State of California
State Board	State Water Resources Control Board
SWAMP	Surface Water Ambient Monitoring Program
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey



# 1.0 Introduction

The Monitoring and Analysis Plan (MAP) is a living document that is updated yearly as part of the San Joaquin River Restoration Program (SJRRP) planning and reporting process to provide a long-term strategy and present revised information needs based on the status of SJRRP implementation. Because there is uncertainty associated with implementation, data collection and analyses, priority is directed toward collecting data that is most meaningful to inform these uncertainties. The MAP presents a directed approach to define the conditions for successful implementation of the SJRRP and prioritizing projects and multi-year studies that directly contribute to understanding those conditions.

The MAP presents both immediate and long-term objectives to address uncertainties associated with implementing the SJRRP. The immediate objectives of the MAP are to identify monitoring and study activities planned for 2013 to support implementation of the SJRRP, and to solicit feedback on 2013 activities through the public review process. The MAP also provides a long-term strategy by identifying actions identified in the *Working Draft Framework for Implementation* (SJRRP, 2012b) for the SJRRP, identifying timelines for completing those actions, highlighting uncertainties and areas of concern, and identifying challenges associated with setting the future direction. A description of the data collected in support of studies to address objectives and to monitor long-term status and trends associated with physical and biological conditions of the San Joaquin River (SJR) are presented in the MAP.

## 1.1 Settlement Background

Agencies responsible for implementing the SJRRP (Implementing Agencies) include the U.S. Department of the Interior, Bureau of Reclamation (Reclamation); U.S. Fish and Wildlife Service (USFWS); California Natural Resources Agency; California Department of Water Resources (DWR); California Department of Fish and Game (DFG); U.S. Department of Commerce; and National Marine Fisheries Service (NMFS). Implementing Agencies of the SJRRP are developing an approach to address water management; Restoration Flows; channel and structural improvements; and reintroduction of salmonids, identified in the Stipulation of Settlement in *NRDC, et al., v. Kirk Rodgers, et al.* (Settlement) to meet or improve the success of SJRRP implementation. Collecting data and performing analysis to address questions about how the SJR will function under implementation of the Settlement will inform approaches for addressing the issues mentioned above. Questions have been identified or will be identified. Data collection and technical analyses will center on physical and biological processes that affect information needs identified in the Settlement and will contribute to reducing uncertainties related to addressing the questions.

These approaches are being developed to meet the two primary goals of the Settlement. The primary goals are as follows:

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

8       To meet the Restoration Goal, the Implementing Agencies are faced with the challenge of  
9       identifying physical and biological conditions that would support restoring and  
10      maintaining fish in “good condition,” and how those physical and biological conditions  
11      should be met through implementing actions. The Settlement and Implementing Agencies  
12      have defined a list of potential projects and actions developed through site-specific  
13      studies and the Program Environmental Impact Statement/Report (PEIS/R) (SJRRP,  
14      2012a). These actions are identified and described in the *Working Draft Framework for*  
15      *Implementation* (SJRRP, 2012b). Actions for meeting the Restoration Goal would result  
16      in the conveyance of nondamaging flows and provide, at a minimum, a migration  
17      corridor for Chinook adult and juvenile salmon to complete their lifecycle. Core actions  
18      for meeting the Water Management Goal would result in completion of the actions  
19      identified in the Settlement and SJRRP Settlement Act (Act) to reduce or avoid water  
20      supply impacts as a result of Interim and Restoration flows. Additional actions identified  
21      by Implementing Agencies are categorized by themes that are associated with the  
22      questions to be addressed in understanding how the SJR will function under  
23      implementation of the SJRRP.

## 24      **1.2 MAP Organization and Development Process**

25      To meet the Restoration and Water Management goals, the Implementing Agencies  
26      identified actions that have been categorized into themes to describe characteristics of a  
27      viable program. These themes are as follows:

- 28      • **Flow Management** – Encompasses all actions under Paragraph 13 of the  
29      Settlement, including operational actions at Friant Dam, compliance with  
30      hydrographs defined in the Settlement, recapture accounting, scheduling, water  
31      acquisitions, banking, and permit requirements.
  
- 32      • **Conveyance** – Involves establishing nondamaging channel capacities to allow  
33      releases that provide for fish movement and to maintain acceptable water  
34      temperatures.
  
- 35      • **Entrainment Protection** – Includes actions to screen diversion facilities and  
36      identify whether other diversions will entrain large numbers of emigrating  
37      juveniles to prevent the loss of juvenile salmon.

- 1       • **Predation** – Includes studies to assess and limit predation of juvenile salmon that  
2 affects migration survival and impedes the SJRRP from meeting fish population  
3 targets.
- 4       • **Rearing Habitat** – Involves establishing or improving rearing habitat to promote  
5 a healthy salmon population in the SJR.
- 6       • **Spawning and Incubation** – Involves identifying and providing appropriate  
7 conditions to improve survival and hatch eggs successfully.
- 8       • **Adult Migration Paths** – Includes actions to remove false migration paths that  
9 lead to unsuitable spawning habitat, being trapped, or prohibiting fish from  
10 traveling to suitable habitat in time to reproduce.
- 11       • **Fish Passage** – Involves creating a reliable passage corridor to help fish move  
12 down and up the SJR to complete their life cycles.
- 13       • **Fish Reintroduction** – Includes conducting a series of efforts to further  
14 understand the reintroduction process through developing a captive Chinook  
15 salmon broodstock, conducting expanded studies to address key uncertainties, and  
16 implementing pilot Chinook salmon release efforts to test and refine strategies.
- 17       • **Water Management** – Encompasses actions that include identifying, developing,  
18 and implementing projects and programs to reduce or avoid adverse water supply  
19 impacts to all of the Friant Division long-term contractors that may result from  
20 the Interim and Restoration flows provided for in the Settlement.

21 This MAP groups actions, questions, and studies by the above-mentioned themes.  
22 Prioritizing implementation of actions is driven by meeting the scientific needs to address  
23 uncertainties and the schedules for potential projects and actions described in the  
24 Settlement, Public Law 111-11, environmental compliance, and Restoration  
25 Administrator (RA) recommendations.

26 Questions associated with each theme will be presented in the MAP. The list of questions  
27 will be updated and revised as new information becomes available through data  
28 collection and analyses. During the next year, the SJRRP anticipates convening  
29 interdisciplinary study groups tasked with the goal of refining questions and reevaluating  
30 uncertainties associated with each theme. The interdisciplinary study groups will provide  
31 an opportunity to (1) develop integrated approaches to addressing remaining  
32 uncertainties, and (2) reduce the potential for assessments that have little or no value  
33 when completed as stand-alone studies. The interdisciplinary study groups will convene  
34 multiple times throughout the year to establish an adaptive approach to prioritizing and  
35 addressing questions.

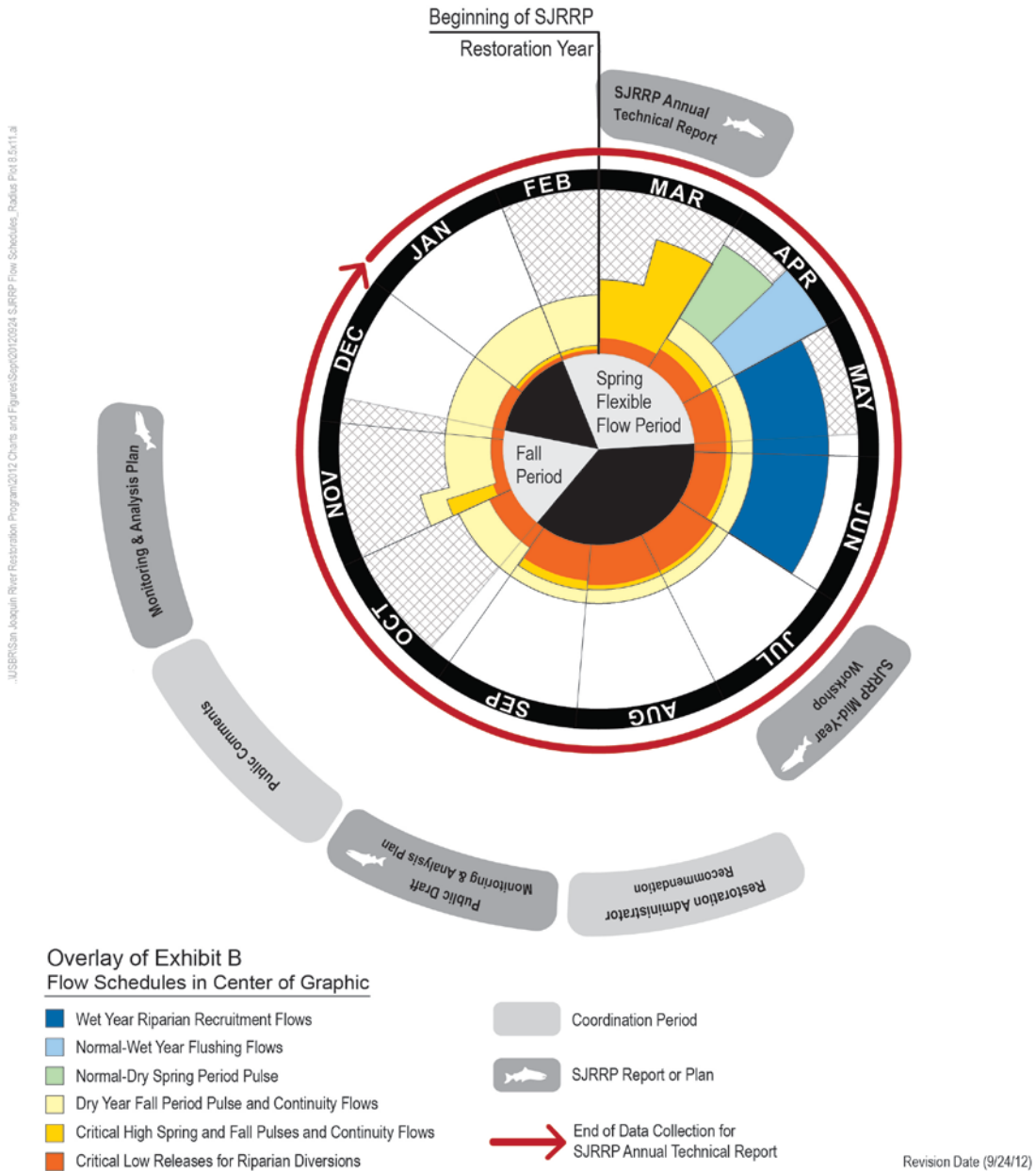
36 The studies define hypotheses and provide rationale for identifying the types of  
37 information needed to support SJRRP decisions and actions, including actions such as  
38 modeling, monitoring, and analysis activities. Studies may be completed in 1 year or

1 may span multiple years and would typically consist of monitoring or data gathering  
2 during a short-term period to address an uncertainty.

3 The MAP also presents studies that may be implemented in response to information  
4 needs identified in resource-specific Monitoring and Management Plans (MMP). The  
5 current role of the MMPs is to identify information needs and describe specific  
6 knowledge gaps to be addressed through monitoring and studies. The MMPs are intended  
7 to track long-term implementation approaches.

8 The MAP follows the SJRRP annual planning and reporting process (see Figure 1-1),  
9 which includes the MAP, Mid-Year workshop and data report, and Annual Technical  
10 Report (ATR). The studies presented in this MAP are planned for 2013 and will be  
11 reported in the 2013 ATR. The 2013 ATR will also consist of updates to the MMPs to  
12 reflect the current state of resource-specific knowledge. Site-specific project and agency  
13 actions will be described further based on their current status in the 2013 ATR.

14 The MAP is developed with input from the Implementing Agencies, RA, stakeholders,  
15 and other technical specialists to define appropriate data needs and study methods,  
16 including both scope and accuracy of the study plans, to support decisions, and  
17 appropriate monitoring and/or analysis used to obtain the data. The SJRRP makes the  
18 MAP available in draft form for public review before finalizing plans for the following  
19 year. The public review period provides an opportunity for the public to read and submit  
20 comments on the document. Following the public review period, the public comments  
21 will be evaluated and considered for revising the MAP.



1  
2  
3

**Figure 1-1.**  
**Monitoring and Reporting Schedule**

4 **1.3 Document Organization**

5 Document organization is discussed below.

6 **Section 2, Monitoring Status and Trends** – Describes the long-term monitoring  
7 performed to meet Settlement requirements and to record status and trends for different  
8 physical and biological conditions.

- 1 **Section 3, Actions, Questions, and Studies** – Describes actions that address key  
2 questions; questions needing decisions to implement the Settlement, legislation, and  
3 program goals; and studies that focus on addressing uncertainties.
- 4 **Section 4, Environmental Compliance** – Describes monitoring and analysis  
5 components that are incorporated into actions to meet permit conditions and  
6 commitments in environmental documents.
- 7 **Section 5, Monitoring Network** – Describes the components monitored and presentation  
8 of current and proposed monitoring locations.
- 9 **Section 6, Analytical Tools** – Describes available numerical models and other technical  
10 tools used to analyze monitoring data and proposed revisions to analytical tools.
- 11 **Section 7, Monitoring Activities Summary** – Summarizes the schedule and budget for  
12 monitoring activities in 2013.
- 13 **Section 8, Conclusions** – Summarizes the anticipated outcomes of 2013 monitoring and  
14 analysis activities.
- 15 **Section 9, References** – List of sources used to compile this MAP.
- 16 **Appendix A Studies** – Presents of studies selected for implementation in 2013. The  
17 studies presented in Appendix A are supported by information collected from the  
18 monitoring network, and analysis conducted using available analytical tools presented in  
19 Sections 5 and 6. The studies presented in Appendix A were prioritized based on efforts  
20 to address key actions consistent with the SJRRP implementation schedule, and are  
21 described in the *Working Draft Framework for Implementation* (SJRRP, 2012b).
- 22 **Appendix B Restoration Administrator Recommendations for 2013 Priority**  
23 **Monitoring and Assessment Actions** (placeholder)
- 24 **Appendix C Budget Summary** –Provides a summary the budget for each study during  
25 2013.
- 26

# 1 2.0 Monitoring Status and Trends

2 The SJRRP conducts long-term monitoring to meet Settlement requirements and to  
3 record status and trends for different physical and biological parameters. Long-term  
4 monitoring efforts can be used to inform the Implementing Agencies of how management  
5 actions relate to and affect conditions in the Restoration Area. Long-term monitoring may  
6 also be used to demonstrate effectiveness of actions implemented under the SJRRP. The  
7 SJRRP reports this data on an annual basis in the ATR and the monitoring data is used to  
8 answer questions related to studies described in Section 3, “Actions, Questions, and  
9 Studies.”

## 10 2.1 Flow and Stage Monitoring

11 The Implementing Agencies conduct stream gaging to understand river conditions and  
12 collect information to address actions. In addition to flow gage monitoring, sensors at  
13 these sites also include a probe for detecting water temperature, DO, electrical  
14 conductivity, and chlorophyll.

15 Table 2-1 lists the stations that collect flow and stage data that undergo quality  
16 assurance/quality control (QA/QC). Flow data from other stations along the San Joaquin  
17 River that have not undergone QA/QC are available at the California Data Exchange  
18 Center (CDEC).

19  
20

**Table 2-1.  
California Data Exchange Center Flow and Stage Measurement Stations**

Stations
SJF – Below Friant Dam*
DNB – Donny Bridge
GRF – Gravelly Ford*
SJB – Below Chowchilla Bifurcation Structure*
SJN – San Mateo Ave.
MEN – Near Mendota Dam
SDP – Sack Dam near Dos Palos*
SWA – Washington Road*
ELN – El Nido
SJS – Stevinson
FFB – Fremont Ford Bridge
SMN – Merced Confluence*

Key:

\* Settlement requires flow monitoring at these stations.

## 1 **2.2 Temperature Monitoring**

2 DFG and Reclamation collect surface water temperature data from sites along the SJR for  
3 the purpose of monitoring the status and tracking trends of the surface water temperature  
4 regime. The locations of temperature monitoring stations throughout the SJRRP reaches  
5 are presented in the *Temperature Atlas* at <http://restoresjr.net/flows/WaterQuality>  
6 (SJRRP, 2012d).

## 7 **2.3 Groundwater Monitoring**

8 Reclamation collects groundwater elevation data from the SJRRP groundwater  
9 monitoring well network to inform seepage management. The *Seepage Management Plan*  
10 (SJRRP, 2011) describes monitoring and operating guidelines for reducing Interim or  
11 Restoration flows to address any material adverse impacts caused by Interim and  
12 Restoration flows in the SJR identified by the SJRRP groundwater monitoring program.

13 The SJRRP groundwater monitoring well network includes 148 wells installed by the  
14 program, excluding temporary wells. A single monitoring well atlas that reports  
15 groundwater levels for 254 wells, including the SJRRP groundwater monitoring wells,  
16 temporary wells, and other wells in the vicinity of the SJR and is published at  
17 <http://www.restoresjr.net/flows/Groundwater> (SJRRP, 2012e).

## 18 **2.4 Terrain**

19 Terrestrial and bathymetrical light detection and ranging (LiDAR), and color infrared  
20 and/or hyperspectral aerial imagery will be collected on an annual basis.

## 21 **2.5 Vegetation Monitoring**

22 Riparian vegetation along the SJR between Friant Dam and the Mendota Pool has been  
23 significantly modified by agricultural development, hydrologic changes from operations  
24 of Friant Dam, and construction and operation of flood control levees and the bypass  
25 system.

26 Twenty permanent vegetation transects were established within Reaches 1A, 1B, 2A, 2B,  
27 3, 4A, and 4B2 (i.e., San Luis National Wildlife Refuge), and the Eastside and Mariposa  
28 bypasses (Study 23, Appendix A). Vegetation transects are monitored annually to  
29 monitor status and trends of plant cover, composition, overstory height, and stem density  
30 along each transect.



## 1 **2.6 Sediment**

2 The U.S. Geological Survey (USGS) will continue collecting sediment data in 2013 as  
3 part of an annual monitoring program (Study 21, Appendix A). Sediment data collected  
4 includes suspended sediment, bedload, and bed material to monitor long-term changes in  
5 geomorphology.

6 USGS is also conducting a study to collect continuous surrogate measurements of  
7 bedload sediment transport using hydrophone installations on the SJR (Study 18,  
8 Appendix A). The objective of this study is to evaluate the use of hydrophone stations for  
9 estimating coarse bedload sediment transport dynamics at high temporal resolutions (e.g.,  
10 hourly or finer) on the main stem SJR downstream from Friant Dam for water years 2013  
11 and 2014. Three separate types of installations will be evaluated: two stereo hydrophone  
12 installations and one “Quadrphone” (double stereo) installation co-located at existing  
13 bedload sampling locations for measuring coarse bedload transport rates, and two stereo  
14 hydrophone installations located at riffle sites for estimating thresholds of coarse bedload  
15 mobilization and cessation. Each type of hydrophone installation will be evaluated for its  
16 accuracy in estimating coarse bedload transport rates and bed mobilization using data  
17 collected by other studies funded by the SJRRP. In particular, the hydrophone data will  
18 be evaluated for the ability to “tune” hydrophone response to the relative low rates and  
19 low bedload grain sizes present on the SJR. In addition, the ‘Quadrphone’ installation  
20 will be assessed for the potential to spatially locate bedload movement within the river,  
21 using calibrated time-of-travel techniques.

22 In addition, USGS is continuing its San Joaquin River Tributary Sediment Transport and  
23 Geomorphology Study (Study 22, Appendix A). The purpose of this study is to quantify  
24 the sediment input from two major tributaries, Cottonwood Creek and Little Dry Creek,  
25 to the San Joaquin River downstream from Friant Dam. The amount and type of sediment  
26 contributed from the two major tributaries is not well understood but likely will play a  
27 substantial role in the sediment budget of the San Joaquin River, given the lack of  
28 upstream sediment supply due to Friant Dam. The amount and timing of fine and coarse  
29 sediment contributed by these tributaries can affect aquatic and riparian species, which  
30 are a focus of the SJRRP.

## 31 **2.7 Biological Monitoring**

32 Multiple studies associated with long-term biological monitoring of status and trends are  
33 presented in this MAP, including the following:

- 34 • Fish Assemblage Inventory and Monitoring (Study 9, Appendix A)
- 35 • San Joaquin River passive integrated transponder (PIT) Tag Monitoring and Site-  
36 Specific Technology Development (Study 15, Appendix A)
- 37 • Macroinvertebrate Surface Water Ambient Monitoring Program (SWAMP)  
38 Bioassessment (see Section 13, Appendix A, 2012 MAP, for complete study plan)

1 **2.7.1.1 Fish Assemblage Inventory and Monitoring**

2 To assess achievement of the Restoration Goal an inventory and monitoring program is  
3 being conducted to identify fish abundance and diversity within the Restoration Area  
4 (Study 9, Appendix A). Describing a baseline fish assemblage within the Restoration  
5 Area during the beginning stages is useful for long-term monitoring. Information on  
6 chronological analysis of the temporal and spatial distribution, relative abundance, and  
7 diversity of fish species will help with the SJRRP Restoration Goal's success. This  
8 information can also be used to adaptively manage future efforts for a more effective  
9 implementation of the Restoration Goal.

10 **2.7.1.2 San Joaquin River PIT Tag Monitoring and Site-Specific Technology**  
11 **Development**

12 The SJR is highly regulated and water flow decisions may impact juvenile Chinook  
13 salmon downstream migration patterns. Data recorded from the SJR PIT Tag Monitoring  
14 and Site-Specific Technology Development Study can be used to determine areas that  
15 contribute to salmon mortality, migration rate, and emigration routes through the  
16 Restoration Area under a variety of flow conditions (Study 15, Appendix A). This  
17 information will be used to better inform management while making decisions regarding  
18 reintroduction timing and flows, and pathways through the system that provide the  
19 greatest chance for survival. These data will also be used to estimate reach-specific and  
20 Restoration Area-wide juvenile Chinook salmon survival rates providing more accurate  
21 information for the Emigrating Salmonid Habitat Estimation model to predict the number  
22 of juvenile production to meet the SJRRP population goals. These data can be used to  
23 better understand the survival and migration paths of juvenile Chinook salmon while  
24 adaptively managing future decisions toward reaching the Restoration Goal.

25 PIT tag monitoring is planned to continue in 2013 after the study is initiated in 2012.

26 **2.7.1.3 Macroinvertebrate SWAMP Bioassessment**

27 Restoration Flows are intended to be sufficient in condition to provide habitat that meets  
28 life history requirements of Chinook salmon (*Oncorhynchus tshawytscha*) and other  
29 native fishes in the SJR. These requirements include habitat characteristics such as good  
30 water quality and availability of food resources. When attempting to restore a river and  
31 its extirpated fishery, a key element of the habitat is the benthic macroinvertebrate  
32 assemblage because it can be used to indicate water quality and is a primary food source  
33 for fish. Thus, biological assessment of the benthic community will provide information  
34 to evaluate the impact of Restoration Flows on salmonid riverine habitat.

35 This study corresponds to the second year of a planned 3-year collaborative study by  
36 DWR and DFG (see Section 13, Appendix A, 2012 MAP, for complete study plan).

## 3.0 Actions, Questions, and Studies

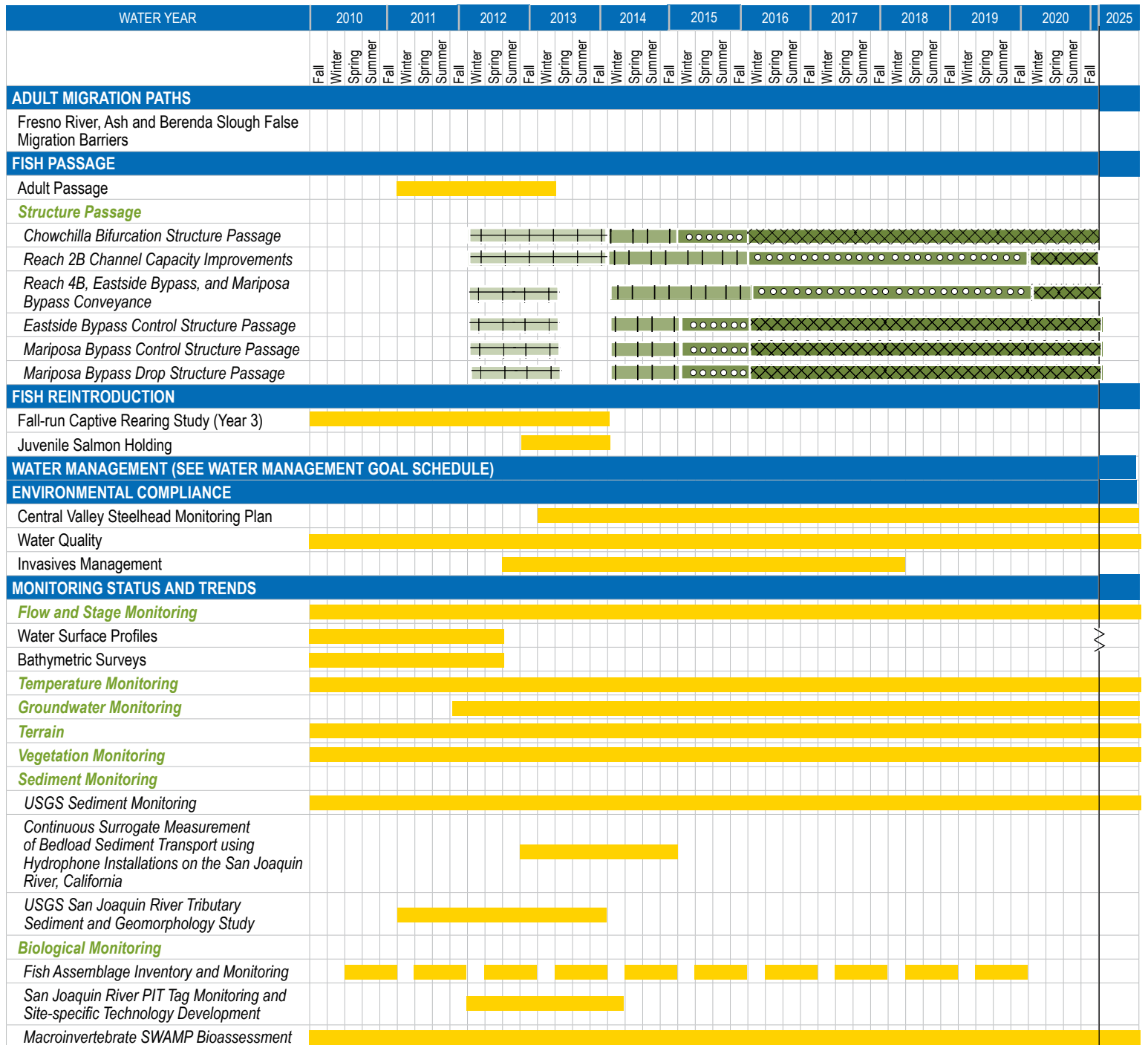
The MAP presents a long-term approach for planning and implementation of the SJRRP. As part of this approach, actions and uncertainties have been identified. This section is organized by themes that describe the characteristics for successful implementation of the SJRRP to help prioritize potential actions (see Section 1.0 for list of themes). These themes represent objectives for which additional information will be collected in consideration of releasing and conveying Interim and Restoration flows, reintroducing fish and providing for fishery needs, protecting Third Parties, and reducing or avoiding water supply impacts. Questions will be identified under each theme to identify the areas of uncertainty associated with implementation of the SJRRP. Actions have been identified below under each theme to support further addressing the information needs. The SJRRP released a draft schedule for implementing actions to support meeting the Restoration Goal and Water Management Goal in the *Working Draft Framework for Implementation* (SJRRP, 2012b). This schedule, and the schedule for individual studies submitted and planned for implementation during 2013, related to the themes described below are presented in Figure 3-1.

Data collection and monitoring activities supporting studies addressing actions will be prioritized based the schedules presented in Figure 3-1. In addition to using the schedules presented in Figure 3-1, the interdisciplinary study groups will collectively use its expertise to suggest the order in which data collection and monitoring activities are implemented or the order for prioritization to address evolving uncertainties. The interdisciplinary study groups will be focused on the following areas of uncertainty:

- Chinook Salmon Spawning habitat
- Chinook Salmon Rearing habitat
- Chinook Salmon Adult migration
- Channel capacity
- Chinook Salmon Juvenile predation
- Real-time flow scheduling

The interdisciplinary study groups will also focus on the key questions to be addressed and use an adaptive management approach to guide SJRRP activities towards meeting the Restoration Goal and Water Management Goal.





KEY	
	Conservation Facility Complete
	Complete Fish Passages at Flow Control Structures
	Conservation Facility Fully Operational
	Mendota Pool Bypass Complete
	Full Fish Releases
	Levee Geotechnical Exploration
	Revise Channel Capacity Constraints
	Monitoring and Analysis/Activity
	Potential Monitoring and Analysis/Activity
	Feasibility Study
	NEPA/CEQA Compliance
	Final Design
	Construction
	Operational

1 This section describes the current level of understanding or ongoing efforts associated  
2 with each theme, the key questions to be addressed associated with each theme, the  
3 proposed actions identified in the *Working Draft Framework for Implementation* (SJRRP,  
4 2012b), studies planned for 2013 associated with addressing the actions, and a schedule  
5 for completion of actions (presented in Figure 3-1). Complete studies are provided in  
6 Appendix A.

## 7 **3.1 Flow Management**

8 Flow management encompasses all actions under Paragraph 13 of the Settlement. Actions  
9 under Paragraph 13 include operational actions at Friant Dam, compliance with  
10 hydrographs defined in the Settlement, recapture accounting, scheduling, water  
11 acquisitions, banking, and permit requirements. Reclamation currently implements these  
12 actions through a program of Interim Flows, development of Restoration Flow  
13 Guidelines, and the MAP and MYTR/ATR.

### 14 **3.1.1 Actions**

15 Actions associated with flow management, identified in the *Working Draft Framework*  
16 *for Implementation* (SJRRP, 2012b), include the following:

- 17 • Stream gage monitoring releases from Friant Dam and locations specified in  
18 Exhibit B of the Settlement.
- 19 • Monitoring of unexpected seepage losses and unreleased Restoration Flows.

20 A long-term question to be addressed for successful implementation is the concept of  
21 flow scheduling to facilitate fish survival and migration. This is one of the key questions  
22 for SJRRP, because flow management provides a potentially powerful tool for  
23 influencing fish survival and migration. The Interim and Restoration flows' flexible flow  
24 period allows managing of releases to meet SJRRP objectives. Implementing Agencies  
25 have the ability to manage the timing, magnitude, and duration of water releases.  
26 However, the trade-offs of flow flexibility for temperature management; providing  
27 floodplain habitat; or providing pulse flows to initiate fish migration needs to meet  
28 SJRRP goals are not well understood. Additional actions that have been identified by  
29 Implementing Agencies to understand these trade-offs include the following:

- 30 • **Acquire Water for Unexpected Seepage Losses** – Acquisition of water or  
31 options on water to meet flow targets consistent with the Restoration Flow  
32 Guidelines and Paragraph 13(c) of the Settlement.
- 33 • **Bank or Store Unreleased Restoration Flows** – Use of water not released for  
34 any reason consistent with the Restoration Flow Guidelines and Paragraph 13(j)  
35 of the Settlement.

### 36 **3.1.2 Questions**

37 <To be included in final 2013 MAP.>

### 1 **3.1.3 Studies**

2 Two studies planned for implementation in 2013 focus on addressing uncertainties  
3 associated with flow management:

- 4 • Flow Gage Record Analysis (Study 1, Appendix A)
- 5 • Temperature Monitoring of Cold Water Pool in Millerton Lake (Study 5,  
6 Appendix A)

#### 7 **3.1.3.1 Flow Gage Record Analysis**

8 The flow gage record analysis study is planned for 2013 and is related to the flow  
9 management theme. This study addresses a key program question of understanding  
10 unexpected seepage losses downstream from Friant Dam. This study will inform  
11 compliance flow releases at Friant Dam to achieve Gravelly Ford flow targets, and also  
12 inform the potential for purchased water. The schedule for completing this study will  
13 align with the SJRRP planning and reporting process and the study will be completed for  
14 the 2013 ATR.

15 This is the second year of the historical and water year flow gage record analysis study.  
16 As mentioned, the study will take place in 2013 and will repeat annually. Data collected  
17 to support this study includes flow gage monitoring, described in Section 4, Monitoring  
18 Status and Trends.

#### 19 **3.1.3.2 Temperature Monitoring of Cold Water Pool in Millerton Lake**

20 Temperature monitoring of the cold water pool in Millerton Lake will provide data to  
21 support consideration of management actions to release flows from higher in the water  
22 column as a potential solution to improve temperature conditions for fisheries. Because  
23 water temperatures affect all life stages of Chinook salmon, it is critical to address the  
24 key question of whether the temperature of inflows to the SJR from Millerton Lake will  
25 provide a suitable fisheries habitat. The availability and the effect that the Millerton Lake  
26 cold water pool has on instream river temperatures are not well understood. Water  
27 temperature in the lake is being monitored to evaluate how releases from Millerton  
28 Lake's cold water pool relate to instream SJR temperatures.

29 This is the second year of the Millerton Lake cold water pool management study. The  
30 study will take place again in 2013 and may repeat annually until Implementing Agencies  
31 conclude that sufficient information has been collected for proposing and implementing  
32 flow scheduling to support temperature management.

## 33 **3.2 Conveyance**

34 Conveyance involves establishing nondamaging channel capacities to allow releases that  
35 provide for fish movement and to maintain acceptable water temperatures. The PEIS/R  
36 calls for Restoration Flows to be limited to then-existing channel capacity based on U.S.  
37 Army Corps of Engineers criteria for levee through- and under-seepage. Potential actions  
38 to increase channel capacity and thereby establish additional conveyance include

1 constructing levee setbacks for physical capacity, improving levee stability to maintain  
2 the flood control project, and constructing new seepage projects to reduce or avoid  
3 material adverse impacts from groundwater seepage.

4 Reclamation and other Implementing Agencies are currently completing site-specific  
5 environmental compliance documentation for actions under the Reach 2B Channel  
6 Capacity Improvements and Mendota Pool Bypass Improvements and Reach 4B,  
7 Eastside Bypass, and Mariposa Bypass Conveyance Improvement projects, consistent  
8 with Paragraph 11 of the Settlement. Environmental documentation for these actions is  
9 anticipated on the following schedule:

- 10 • Draft Environmental Impact Statement/Report (EIS/R) for Reach 2B Channel  
11 Capacity Improvements and Mendota Pool Bypass Improvements is anticipated to  
12 be released in spring 2013
- 13 • Final EIS/R for Reach 2B Channel Capacity Improvements and Mendota Pool  
14 Bypass Improvements is anticipated to be released in summer 2014
- 15 • Draft EIS/R for Reach 4B, Eastside Bypass, and Mariposa Bypass Conveyance  
16 Improvements is anticipated to be released in January 2013

17 Collecting data on levee materials is used to determine levee stability risks. In the  
18 absence of sufficient data to evaluate levee stability, Reclamation is dedicated to  
19 maintaining flows below the outside toe. Levee constraints currently limit flows at the  
20 following locations:

- 21 • Upstream from the Mendota Pool to 810 cubic feet per second (cfs) in Reach 2B
- 22 • Below Sack Dam to 600 cfs in the Eastside Bypass

23 Other current efforts to support evaluation of levee stability include geotechnical  
24 investigations underway by DWR to collect relevant data to identify and prioritize  
25 bottleneck areas for levee remediation.

26 Reclamation developed a *Seepage Management Plan* (SJRRP, 2011) in coordination with  
27 the landowners, last updated in March 2011, which lays out a groundwater monitoring  
28 network and identifies thresholds in wells within the monitoring network. Reclamation  
29 limits the release of Interim Flows to flow rates that do not cause groundwater levels to  
30 rise above thresholds. Reclamation can sometimes recapture a portion of the releases  
31 from Friant Dam to reduce or avoid downstream impacts from groundwater seepage.  
32 Seepage constraints currently limit flows upstream from the Mendota Pool to 2,100 cfs in  
33 Reach 2A. Seepage constraints vary seasonally and by hydrology below Sack Dam, and  
34 currently limit flows to between zero and 140 cfs in the Eastside Bypass between the  
35 Sand Slough Control Structure and Mariposa Bypass Bifurcation Structure.

36 The PEIS/R also calls for addressing seepage effects through easements and/or  
37 compensation for seepage effects to landowners. Implementing physical or real-estate-



1 related seepage projects will allow higher flow rates without groundwater levels rising  
 2 above thresholds. Reclamation, in coordination with landowners, has nearly completed  
 3 developing a *Seepage Project Handbook*, which specifies the process for working with  
 4 landowners, and timelines for implementing seepage projects. Reclamation has initiated  
 5 several seepage projects to increase nondamaging conveyance capacity.

### 6 **3.2.1 Actions**

7 Several actions have been identified by the Implementing Agencies as part of the  
 8 *Working Draft Framework for Implementation* (SJRRP, 2012b) related to the conveyance  
 9 theme that include the following:

- 10 • Levee improvements for lengths impacted at 2,000 cfs conveyance in Reaches  
 11 2A, 3, 4A, and 5.
- 12 • **Up to 2,000 cfs of conveyance by 2016** – This action suggests that seepage  
 13 improvements be made for parcels impacted at 2,000 cfs conveyance in Reaches  
 14 2A, 3, 4A, and 5.
- 15 • **Reach 2B Channel Capacity Improvements** – This would include construction  
 16 of levees for 4,500 cfs capacity without engineering floodplain habitat through  
 17 grading or planting of vegetation. Temperature criteria identified a conveyance of  
 18 2,000 cfs as a core need. Although construction of the Mendota Pool Bypass may  
 19 accomplish nondamaging conveyance near 2,000 cfs, the Implementing Agencies  
 20 included this as an action to meet requirements in Paragraph 11(a) of the  
 21 Settlement. Conveyance levels from seepage and levee stability actions show  
 22 incremental improvements to existing levees as an alternative to constructing the  
 23 4,500 cfs Settlement project. Construction would include relocations, levee  
 24 construction, partial removal of existing levees, and riprap bank protection on  
 25 Bend 10.
- 26 • **Reach 4B, Eastside Bypass, and Mariposa Bypass Conveyance** – This would  
 27 include constructing flow routing facilities at the Sand Slough Control Structure,  
 28 levee construction or repair, low-flow channel excavation, and transportation  
 29 crossing improvements in either the old river channel or the flood bypass system.  
 30 A series of channel capacity constraints in these areas prevent the conveyance of  
 31 2,000 cfs.

32 Another action for seepage was identified by the Implementing Agencies in the *Working*  
 33 *Draft Framework for Implementation* (SJRRP, 2012b) that suggests seepage  
 34 improvements be made between 2019 and 2023 for parcels impacted at greater than 2,000  
 35 cfs.

### 36 **3.2.2 Questions**

37 <To be included in final 2013 MAP.>

1 **3.2.3 Studies**

2 Studies planned for implementation in 2013 addressing conveyance issues include the  
3 following:

- 4 • Levee Geotechnical Exploration (Study 13, Appendix A)
- 5 • Lateral Gradient of Water Table (Study 2, Appendix A)
- 6 • Changes in Soil Salinity Conditions Resulting from Interim Flows (Study 3,  
7 Appendix A)
- 8 • Influence of Paleochannels on Seepage (Study 4, Appendix A)
- 9 • Additional Water Level Recorders (Study 24, Appendix A)
- 10 • Monitoring Cross-Section Resurveys (Study 25, Appendix A)

11 **3.2.3.1 Levee Geotechnical Exploration**

12 The Levee Geotechnical Exploration Study will evaluate the potential risk impacts of  
13 Interim and Restoration flows under the SJRRP. As an early step in the process, obtaining  
14 geotechnical information on existing levees in the SJR and flood bypasses will help  
15 evaluate the geotechnical integrity of levees. This study will develop preliminary  
16 information to address the action that identifies potential levee improvements for lengths  
17 impacted at 2,000 cfs conveyance in Reaches 2A, 3, 4A, and 5, and the Eastside Bypass.

18 The Levee Geotechnical Exploration Study is anticipated to be completed in 2013.  
19 Following levee geotechnical exploration, progress on levee stability evaluation is  
20 proposed to proceed on the following schedule.

- 21 • **2014** – Revision of channel capacity constraints following completion of levee  
22 evaluation
- 23 • **2015** – Completion of environmental compliance and design
- 24 • **2016** – Initiation of construction activities

25 **3.2.3.2 Lateral Gradient of Water Table**

26 The Lateral Gradient of Water Table Study will provide information including the  
27 following: (1) lateral extent of influence from surface water flow in Reach 4A on the near  
28 river, shallow groundwater system response, (2) relationships of surface water flows to  
29 other groundwater influences, such as rainfall, irrigation of fields, and canal conveyance  
30 facilities, and (3) changes in the soil salinity profile and movement of salts from different  
31 sources. This study will inform the key question of identifying where seepage concerns  
32 exist, and also improve SJRRP understanding to support updates to the *Seepage*  
33 *Management Plan* (SJRRP, 2011).

34 This is the second year of the Lateral Gradient of Water Table Study. This study will take  
35 place in 2013 and may repeat annually until the Implementing Agencies conclude that

1 sufficient information has been collected to propose and implement seepage management  
2 actions.

### 3 **3.2.3.3 Changes in Soil Salinity Conditions Resulting from Interim Flows**

4 The Changes in Soil Salinity Conditions Resulting from Interim Flows Study will  
5 establish baseline salinity levels for seepage-prone areas, and quantify salinity changes  
6 over time so that the presence of shallow groundwater during Interim Flows may be  
7 understood in relation to existing conditions. This study will also inform the key question  
8 of identifying where seepage concerns exist, and improve SJRRP understanding to  
9 support updates to the *Seepage Management Plan* (SJRRP, 2011).

10 This is the second year of the Changes in Soil Salinity Conditions Resulting from Interim  
11 Flows Study. This study will take place in 2013 and may repeat annually until the  
12 Implementing Agencies conclude that sufficient information has been collected to  
13 propose and implement seepage management actions.

### 14 **3.2.3.4 Influence of Paleochannels on Seepage**

15 The Influence of Paleochannels on Seepage Study will address whether (1) paleochannels  
16 exist along the SJR, (2) if the paleochannels exist, the extent of paleochannel influence on  
17 seepage extent, and (3) if the paleochannels exist, changes to project design necessitated  
18 by existence of paleochannels at a site.

19 The field work component of the Influence of Paleochannels on Seepage Study began in  
20 June 2012 and is expected to conclude in September 2012, subject to landowner access  
21 and irrigation schedules. Technical analysis of the data collected for this study will occur  
22 during and after this period. Groundwater modeling to support this analysis will be  
23 conducted in winter 2012 and spring 2013. A draft report is anticipated for the 2012 ATR  
24 in March 2013.

### 25 **3.2.3.5 Additional Water Level Recorders**

26 The Additional Water Level Recorders Study involves collecting data to inform hydraulic  
27 models being used to assess channel capacity, fishery habitat, channel stability, and many  
28 other aspects of SJRRP planning and design. This study was initiated in 2010 and data  
29 collection is ongoing. The current plan is to analyze data and determine if more or  
30 alternative locations should be installed. The analysis will extend through 2012 and into  
31 2013, with the possibility of adding or moving recorders in 2013. The effectiveness of  
32 the recorders and whether recorders should be added or moved will also be periodically  
33 evaluated.

### 34 **3.2.3.6 Monitoring Cross Section Resurveys**

35 The Monitoring Cross Section Resurveys Study involves collecting data to inform the  
36 Implementing Agencies about whether Interim and Restoration flow releases are causing  
37 systematic changes in channel geometry that could lead to a reduction in channel capacity  
38 and stability. This study will continue to provide data that can be used to assess mid- and  
39 long-term changes in channel geometry and substrate characteristics in the sand-bed  
40 portions of a reach in response to the Interim and Restoration flow releases.

1 This study was initiated in 2010 and will continue in summer 2013 if flows occur during  
2 flood season. Analysis of past surveys, including the rate of change and identification of  
3 flow triggers for future surveys, should be complete in 2013.

### 4 **3.3 Entrainment Protection**

5 Entrainment protection includes actions to screen diversion facilities to prevent the loss  
6 of juvenile salmon. Major known locations for juvenile salmon entrainment have been  
7 identified, but questions remain about whether other diversions will entrain large  
8 numbers of emigrating juveniles. The Implementing Agencies are currently developing  
9 plans for implementing these actions to screen Arroyo Canal and bypass the Mendota  
10 Pool. Diversions that were not identified as a known major entrainment problem have  
11 been noted and include riparian diversions and the diversion at Lone Willow Slough.  
12 Additional potential actions described in the *Working Draft Framework for*  
13 *Implementation* (SJRRP, 2012b) would address entrainment at these locations pending  
14 further evaluation of the level of loss and need. These diversions are not expected to  
15 entrain large number of juvenile salmon, but fish monitoring and studies for juvenile  
16 losses will track reach-specific losses.

#### 17 **3.3.1 Actions**

18 Actions associated with entrainment protection include screening the Arroyo Canal and  
19 constructing a bypass at the Mendota Pool. Evaluations of expected diversion rates and  
20 field studies on fish survival identified the Mendota Pool as a potential major source of  
21 juvenile salmon loss through entrainment into water diversions in most years. Bypassing  
22 fish around the Mendota Pool or moving the Mendota Pool into Fresno Slough would  
23 resolve this concern.

#### 24 **3.3.2 Questions**

25 <To be included in final 2013 MAP.>

#### 26 **3.3.3 Studies**

27 No studies are currently underway to directly screen smaller diversions, but the fish  
28 survival studies (Juvenile Survival and Migration (Study 10, Appendix A) and SJR  
29 passive integrated transponder (PIT) Tag Monitoring and Site-Specific Technology  
30 Development (Study 15, Appendix A)) will help determine the location of losses and  
31 guide targeted studies. Flow levels comparable to anticipated Restoration Flows and a  
32 complete migration corridor for juvenile salmon will help further understand potential  
33 losses from smaller diversions. Juvenile survival monitoring will identify reach-specific  
34 losses of juveniles, and any areas of large losses can be further investigated with targeted  
35 studies. The PIT tag feasibility study is also a step in developing a system to monitor for  
36 losses by reach and at specific structures. Future fish releases and monitoring efforts will  
37 inform the program on potential losses from these diversions.

## 1 **3.4 Predation**

2 Predation of juvenile salmon can have a large effect on migration survival and impede the  
3 SJRRP from meeting fish population targets. The Settlement calls for addressing gravel  
4 mine pit habitat in the SJR, but other areas have also been identified as predator habitat  
5 that overlaps with the juvenile salmon migration corridor. Given the potential high level  
6 of loss from predation, the expense of remedial actions as integrated approach to  
7 predation management is warranted.

8 Given the cost and difficulty of predator control actions, the SJRRP will investigate  
9 actual losses from predation. If these losses are deemed significant, the SJRRP should  
10 review methods to reduce the predation pressure on migrating salmon and evaluate the  
11 potential for these actions to reduce losses from predation and increase the probability of  
12 meeting fishery objectives.

13 The gravel mine pits and lower SJR reaches (4 and 5) have been identified as areas  
14 suitable for predator populations that should be evaluated. Any structure in the system  
15 can also provide predator habitat; therefore, existing structures should be evaluated for  
16 predation threats, and new structures designed to not provide predator habitat.

### 17 **3.4.1 Actions**

18 Actions associated with this theme include filling and isolating gravel mine pits, and  
19 other predator avoidance and predator management actions. The gravel mine pits in the  
20 Restoration Area have been identified as a potential contributor to juvenile salmon loss.  
21 The gravel pits provide habitat for predatory fish, and the slow current through these  
22 pools can expose juvenile salmon to high predation mortality. The SJRRP is currently  
23 studying predator populations in these gravel mine pits and survival of juvenile salmon  
24 through the gravel mine pits. These studies will advise future actions.

25 Gravel mine pit filling and isolation actions have not been implemented, but the  
26 Implementing Agencies are developing plans for these actions.

### 27 **3.4.2 Questions**

28 <To be included in final 2013 MAP.>

### 29 **3.4.3 Studies**

30 Four studies planned for implementation in 2013 focus on addressing uncertainties  
31 associated with predation and juvenile salmon survival in gravel mine pits in the SJR.  
32 Results from these studies will inform Implementing Agencies whether gravel mine pit  
33 filling and isolation actions would contribute to a successful program. The studies include  
34 the following:

- 35 • Assessment of Predator Abundance and Distribution in Mine Pit Habitat in San  
36 Joaquin River Restoration Area (Study 11, Appendix A)
- 37 • Juvenile Survival and Migration (Year 3 – Telemetry) (Study 10, Appendix A)

- 1 • Two-Dimensional Temperature Modeling of Gravel Pits in Reach 1A (Study 19,  
2 Appendix A)
- 3 • Effect of Altered Flow Regime on Channel Morphology in Reach 1A (Study 26,  
4 Appendix A)

5 **3.4.3.1 Assessment of Predator Abundance and Distribution in Mine Pit Habitat in**  
6 **San Joaquin River Restoration Area**

7 A multiple-year study is currently underway to evaluate predator population composition,  
8 relative abundance, and habitat use within the system. This study will also evaluate  
9 predation of Chinook salmon that have been released into the system. These evaluations  
10 will help resolve to what extent predation is likely to be an issue, and can help focus  
11 efforts to reduce or control predation. In 2013, the juvenile survival study is focused on  
12 evaluating survival within the mine pit complex and integrated with the predator  
13 abundance studies.

14 The Assessment of Predator Abundance and Distribution in Mine Pit Habitat in San  
15 Joaquin River Restoration Area Study will improve understanding of predator  
16 populations in gravel mine pits, and the information collected will allow the  
17 Implementing Agencies to identify the highest priority gravel mining pits to fill.  
18 Prioritizing the mine pits for restoration is a Phase II action in the Settlement.  
19 Additionally, management decisions regarding appropriate release locations for juvenile  
20 salmonids can benefit from information gathered from this study.

21 The Assessment of Predator Abundance and Distribution in Mine Pit Habitat in San  
22 Joaquin River Restoration Area Study is anticipated to be a 5-year effort, with completion  
23 in 2017.

24 **3.4.3.2 Juvenile Survival and Migration (Year 3 – Telemetry)**

25 Restoration of the gravel mine pits is identified as a high priority action in the Settlement,  
26 and studies would help quantify predation risk and, if necessary, the habitats that pose the  
27 greatest risk of predation. Results from this study will inform the Implementing Agencies  
28 on predaceous species of fish that are associated with different river features, including  
29 gravel mine pits, and identify habitats associated with the greatest risk of predation.

30 This study is planned to be implemented in spring/early summer 2013. The work  
31 completed in 2013 will conclude the third year of the overall study.

32 **3.4.3.3 Two-Dimensional Temperature Modeling of Gravel Pits in Reach 1A**

33 The Two-Dimensional Temperature Modeling of Gravel Pits in Reach 1A Study will  
34 improve understanding of the spatial and temporal variations in temperature in the SJR  
35 and adjacent gravel pits. The two-dimensional temperature model proposed for this study  
36 will produce depths and velocities for the study area that can be compared with  
37 documented preferred conditions of predators within the SJR to identify areas and flows  
38 that are favorable to different predator species. An improved understanding of the  
39 interactions between the river and gravel pit water temperatures may also help to identify  
40 the most effective mechanisms to reduce predation potential. An assessment of predator

1 abundance and distribution was conducted within gravel pits present in the study area in  
 2 2012 (SJRRP, 2012c). In addition, ongoing temperature monitoring of the gravel pits and  
 3 river within the study area took place in 2012 and will likely continue in the future  
 4 (SJRRP, 2012c). Data collected from these studies can be combined with results from the  
 5 2D temperature model to examine interactions among hydraulic conditions, temperature,  
 6 and predation. The primary goal of the 2D temperature model is to offer insight for  
 7 controlling water temperatures during critical life stages. In addition, the modeling effort  
 8 may also assist in determining which gravel mine pits may be most favorable to certain  
 9 predator species, and in evaluating restoration techniques to promote hydraulic and  
 10 temperature conditions that would suppress specific predator species during critical life  
 11 stages for juvenile salmonids.

12 Modeling efforts and associated analysis are planned to be implemented in 2013.

#### 13 **3.4.3.4 Effect of Altered Flow Regime on Channel Morphology in Reach 1A**

14 The Effect of Altered Flow Regime on Channel Morphology in Reach 1A Study will  
 15 inform the Implementing Agencies on habitat quality, specifically by collecting data and  
 16 developing modeling predictions of the availability of specific habitat types based on  
 17 flow conditions. Deep pools, which provide temperature and predation refuge, holding  
 18 habitat, and overhanging banks that provide protection from predation, will be evaluated  
 19 as part of this study.

20 This study will also provide information relevant to the rearing habitat and spawning and  
 21 incubation themes. The channel evolution model associated with this study is currently  
 22 under development. Topographic resurveys of riffles and pools are planned for summer  
 23 2013 in Reach 1A if flows are high enough to cause observable bed geometry changes or  
 24 tracer movement.

## 25 **3.5 Rearing Habitat**

26 Flow scheduling is a key question that relates to temperature management, Interim and  
 27 Restoration flows pulse flows for migration, and providing overbank/floodplain habitat.  
 28 Invertebrates associated with juvenile rearing habitat in the floodplain may have some  
 29 bearing on the capability of anadromous salmonids to generate self-sustaining  
 30 populations in this system. Recruitments of aquatic and terrestrial invertebrates will  
 31 provide information, location, and quality of floodplain habitat for rearing habitat, along  
 32 with the potential for survival and growth of inhabiting salmonids.

### 33 **3.5.1 Actions**

34 Actions associated with establishing or improving rearing habitat include grading  
 35 floodplains and planting riparian vegetation. Actions to establish floodplain vegetation  
 36 have not been implemented, but the Implementing Agencies are developing plans for  
 37 these actions. Floodplain grading and vegetation actions would “jump-start” the  
 38 productive potential of floodplain habitat for juvenile salmon. Conveyance actions  
 39 described above assumed minimal or no actions to plant and grade floodplain areas.

1 **3.5.2 Questions**

2 <To be included in final 2013 MAP.>

3 **3.5.3 Studies**

4 Two studies planned for implementation in 2013 focus on addressing uncertainties  
5 associated with rearing habitat. Results from these studies will inform the Implementing  
6 Agencies on whether sufficient rearing habitat is available for a successful program. The  
7 studies include the following:

- 8 • Floodplain Quality (Study 16, Appendix A)
- 9 • Effect of Altered Flow Regime on Channel Morphology in Reach 1A (Study 26,  
10 Appendix A)
- 11 • Thermal Conditions in Riverine Pools (Study 29, Appendix A)

12 **3.5.3.1 Floodplain Quality**

13 The Restoration Goal of the SJRRP includes the return of viable, long-term, and  
14 sustainable populations of naturally reproducing spring- and fall-run Chinook salmon.  
15 To realize restoration of the Lower San Joaquin River salmon populations, successful  
16 completion of the freshwater portion of the life-cycle must occur. Of special importance  
17 is the survival and growth of juvenile salmon in floodplain environments. These  
18 temporarily inundated environments often provide conditions that lead to increased  
19 salmon growth and presumably better survival. The floodplain quality study will inform  
20 the Implementing Agencies on available existing fish habitat.

21 Field work associated with this study is planned for a 3-week period in March and April  
22 2013. Additional technical analyses will take place before field work is initiated and after  
23 completion of field studies.

24 **3.5.3.2 Effect of Altered Flow Regime on Channel Morphology in Reach 1A**

25 The Effect of Altered Flow Regime on Channel Morphology in Reach 1A Study will  
26 inform the Implementing Agencies on habitat quality, specifically by collecting data and  
27 developing modeling predictions of the availability of specific habitat types based on  
28 flow conditions. Flow complexity is beneficial to juvenile rearing and will be evaluated  
29 as part of this study.

30 This study will also provide information relevant to the predation and spawning and  
31 incubation themes. The channel evolution model associated with this study is currently  
32 under development. Topographic resurveys of riffles and pools are planned for summer  
33 2013 in Reach 1A if flows are high enough to cause observable bed geometry changes or  
34 tracer movement.

35 **3.5.4 Thermal Conditions in Riverine Pools**

36 Thermal refugia provide the cold water habitat needed by salmonids when ambient water  
37 temperatures exceed their temperature tolerances. It is created when groundwater,  
38 hyporheic exchange, or a combination of both upwells cold water into the surface water.



1 Upwelling flow forms cold water patches along the streambed and thermal stratification  
2 in riverine pools.

3 This study will be conducted to quantify the amount and quality of thermal refugia in  
4 fifteen different San Joaquin River pools from the Eastside Bypass/Reach 4 to Reach 5.  
5 These locations are to be instrumented from July to August 2012.

## 6 **3.6 Spawning and Incubation**

7 Incubating salmon eggs require appropriate conditions (temperature, spawning gravel  
8 size distribution, water quality including DO and pH, etc.) to survive and hatch  
9 successfully. During spawning activity and redd construction, Chinook eggs are buried in  
10 the substrate, at depths from around 30 centimeters (e.g., DeVries, 1997) to 45  
11 centimeters (Geist, 2000). This relatively deep substrate region is often in the zone of  
12 surface water and groundwater interaction, typically referred to as the hyporheic zone.  
13 Hyporheic conditions within the redd may differ markedly from those found at the  
14 surface (e.g., Soulsby, et al., 2001). Hyporheic conditions may vary widely for different  
15 redds because of variation in channel morphology, groundwater connectivity, and  
16 substrate permeability (Arntzen, et al., 2006).

17 The SJRRP initiated several studies in 2010 to begin addressing uncertainties associated  
18 with spawning and incubation habitat. These multi-year studies are further described  
19 below.

### 20 **3.6.1 Actions**

21 Actions associated with improving spawning and incubation include habitat  
22 improvements such as gravel augmentation and artificial riffle construction. Spawning  
23 habitat augmentation in Reach 1 includes surveys of spawning gravel within the  
24 Restoration Area that identified quality spawning gravel in the upper reaches, and also  
25 identified that some degree of gravel augmentation could support reintroduction  
26 objectives. These actions have not been implemented, but the Implementing Agencies are  
27 developing plans for these actions.

### 28 **3.6.2 Questions**

29 <To be included in final 2013 MAP.>

### 30 **3.6.3 Studies**

31 Five studies planned for implementation in 2013 focus on addressing uncertainties  
32 associated with spawning and incubation. Results from these studies will inform the  
33 Implementing Agencies on whether sufficient spawning and incubation provide adequate  
34 habitat for a successful program. The studies include the following:

- 35 • Egg Survival (Study 8, Appendix A)
- 36 • Bed Material Data Processing and Evaluation (Study 17, Appendix A)

- 1       • Reach 1A Spawning Area Bed Mobility (Study 28, Appendix A)
- 2       • Effect of Scour and Deposition on Incubation Habitat in Reach 1A (Study 27,  
3       Appendix A)
- 4       • Effect of Altered Flow Regime on Channel Morphology in Reach 1A Study 26,  
5       Appendix A)

### 6       **3.6.3.1 Egg Survival**

7       The Restoration Goal of the SJRRP includes the return of viable, long-term, and  
8       sustainable populations of naturally reproducing spring- and fall-run Chinook salmon.  
9       To realize restoration of lower San Joaquin River salmon populations, successful  
10      completion of their freshwater portion of the life-cycle must occur. A proposed  
11      component of this goal is the importation of salmon embryos from an appropriate source  
12      and incubation of those embryos within the lower river to successful emergence. For this  
13      to occur, the gravel environment must not only meet the requirements of spawning  
14      females, it must allow for successful incubation and emergence. While it has been  
15      hypothesized that an appropriate spawning and incubation matrix is available, the last  
16      salmon to successfully spawn in the lower river was over 5 decades ago (McBain and  
17      Trush, 2002). Therefore, the suitability of the available habitat must be fully evaluated.

18     This study addresses several limiting factors (i.e., sedimentation, streamflow,  
19     temperature, gravel quality, and gravel quantity) to the “Healthy Fry Production” life  
20     stage (via egg survival) of Chinook salmon (FMWG, 2009), and provides information on  
21     existing conditions to inform the reintroduction of salmon by 2012 through identifying  
22     factors that may contribute to significant mortality of introduced salmonids.

### 23      **3.6.3.2 Bed Material Data Processing and Evaluation**

24     Bed material information is often used in studies to address potential impacts of flow  
25     releases under the SJRRP on sediment transport, channel morphology, vegetation, and  
26     habitat. With the continuation of Interim Flows and recent flood releases, potential  
27     changes in bed material size distributions and quantities of sand present in the bed  
28     material are unknown. During spring 2009 and again in summer 2012, Reclamation  
29     conducted field visits to collect bed material throughout Reach 1 to compare to historical  
30     bed material data, and to investigate visible changes associated with flow changes  
31     between 2009 and 2012. Evaluating changes in bed material data for short time scales (3  
32     – 5 years) is a step in monitoring how differences in releases from Friant Dam potentially  
33     influence bed material gradations. In addition to monitoring for change, acquired  
34     sediment data may be used in numerical modeling, gravel mobilization studies, and other  
35     investigations of spawning gravel quality. This study proposes to complete processing of  
36     photogrammetric sediment samples and bed material samples conducted in June 2012,  
37     incorporate results into the sediment atlas, and evaluate potential changes in bed material  
38     from historical conditions and between 2009 and 2012.

### 39      **3.6.3.3 Reach 1A Spawning Area Bed Mobility**

40     The Reach 1A Spawning Area Bed Mobility Study would inform a key question  
41     regarding limiting factors associated with healthy fry production that include egg survival

1 and redd superimposition (SJRRP, 2009). Egg survival depends on intragravel flow  
2 delivery of dissolved oxygen (DO), which is influenced by fine sediment content within  
3 gravel interstices. Redd superimposition depends on availability of suitable spawning  
4 gravels relative to the number of spawning pairs. The suitability of spawning gravels is  
5 not only based on grain size composition but also the looseness of bed material such that  
6 it allows ease of redd construction. Therefore, understanding the condition of the stream  
7 bed (i.e., texture, amount of sand and silt, and degree of bed reinforcement) in areas that  
8 are otherwise expected to be suitable for spawning (i.e., have sufficient flow velocity and  
9 depth during spawning and incubation periods) is pertinent to the success of the  
10 restoration effort.

11 This study was initiated in January 2010. Data collection was complete in 2012 and data  
12 reporting will be completed in 2013.

#### 13 **3.6.3.4 Effect of Scour and Deposition on Incubation Habitat in Reach 1A**

14 The effect of scour and deposition on incubation habitat in Reach 1A study will address  
15 uncertainties associated with the potential for excessive scour to expose buried eggs to  
16 abrasive flows and predation, thereby reducing the productivity of redds. This study is  
17 intended to examine the role that discharge plays in influencing successful incubation and  
18 emergence.

19 Field work associated with this study was initiated in 2010 and will extend into 2013.  
20 Data collection and reporting is expected to continue in collaboration with SJRRP egg  
21 survival studies.

#### 22 **3.6.3.5 Effect of Altered Flow Regime on Channel Morphology in Reach 1A**

23 The Effect of Altered Flow Regime on Channel Morphology in Reach 1A Study will  
24 inform the Implementing Agencies on habitat quality, specifically by collecting data and  
25 developing modeling predictions for the availability of specific habitat types based on  
26 flow conditions. Bed texture data collected as part of this study will inform the  
27 Implementing Agencies on existing habitat and the potential for successful incubation  
28 and emergence.

29 This study will also provide information relevant to the predation and spawning and  
30 incubation themes. The channel evolution model associated with this study is currently  
31 under development. Topographic resurveys of riffles and pools are planned for summer  
32 2013 Reach 1A if flows are high enough to cause observable bed geometry changes or  
33 tracer movement.

### 34 **3.7 Adult Migration Paths**

35 False migration paths are pathways that attract adult migrating salmon but do not lead to  
36 suitable spawning habitat. Adults traveling into these false pathways often become  
37 trapped or die in the false pathway. Even if a pathway does not lead to mortality, the  
38 delay to migration can prohibit fish from traveling to suitable habitat in time to  
39 reproduce. Actions associated with this theme would include constructing barriers to

1 prevent adult anadromous fish from straying into false migration pathways. The  
2 Implementing Agencies identified actions to construct the Salt Slough and Mud Slough  
3 barriers to prevent false migration pathways for adult anadromous fish, and are currently  
4 developing plans for implementing these actions. However, no studies are currently  
5 underway to support resolving uncertainties associated with adult migration paths. An  
6 additional potential action identified in the *Working Draft Framework for Implementation*  
7 (SJRRP, 2012b) as an improvement is to include an evaluation of Fresno River, Ash, and  
8 Berenda Slough False Migration Barriers (Chowchilla Bypass).

9 The Kings River Barrier represents one adult pathway that may attract adult salmon from  
10 the San Joaquin River in flood years. The SJRRP should determine the frequency that  
11 the King's River Barrier may attract adult salmon from the Restoration Area and the risk  
12 its operation poses to the SJRRP for meeting fishery population objectives.

13 Potential adult migration pathways may also exist at the Newman Wasteway and  
14 locations within the Chowchilla Bypass (e.g., Ash and Berenda sloughs). Adult  
15 migration monitoring should be at a resolution that will allow the SJRRP to identify the  
16 source of losses within the migration corridor.

17 The timeline for completing these actions is 2013.

### 18 **3.8 Fish Passage**

19 One of the actions identified by the Implementing Agencies is to meet structural and  
20 channel improvements as described in Paragraph 11(a) of the Settlement. Therefore, a  
21 number of specific actions were identified to for next year.

22 For the purpose of planning, the Implementing Agencies assumed that adult salmon will  
23 enter the flood bypasses during wet years.

24 Creating a reliable passage corridor was identified as a means to help fish move down  
25 and up the SJR to complete their life cycles. Adult fish must be able to return to spawn  
26 for salmon reintroduction to be successful. Adult passage impediments can be a  
27 complete barrier that does not allow salmon to continue migrating to spawning grounds.  
28 Major losses through juvenile entrainment can also preclude restoring salmon populations  
29 to the San Joaquin River. Actions to reduce juvenile entrainment were included as  
30 actions where the Implementing Agencies expect a high degree of juvenile loss and a  
31 high expected frequency of occurrence.

32 Actions associated with this theme include establishing acceptable depths, velocities, and  
33 jump heights at structures and road crossings, modifying structures, and maintaining  
34 access across the river, for fish passage. The Implementing Agencies identified numerous  
35 fish passage actions that would have the highest priority for implementation. These  
36 actions include Chowchilla Bifurcation Structure Passage, San Joaquin River Control  
37 Structure Passage, Mendota Pool Bypass, Arroyo Canal Screening and Sack Dam  
38 Passage, Eastside Bypass Control Structure Passage, Mariposa Bypass Control Structure

1 Passage, and Mariposa Bypass Drop Structure Passage. The Implementing Agencies  
 2 identified additional actions that would be prioritized after the actions above that include  
 3 increased conveyance in Reaches 2A, 3, 4A, and 5; San Mateo Road Crossing;  
 4 Chowchilla Bypass Passage at Crossings (Avenue 18 ½ and Avenue 21); and Eastside  
 5 Bypass Passage at Crossings and structures (Dan McNamara Road, Merced National  
 6 Wildlife Refuge Weirs).

7 Reclamation and other Implementing Agencies are currently completing site-specific  
 8 environmental compliance documentation for the above actions consistent with  
 9 Paragraph 11 of the Settlement. The environmental documentation for these actions is  
 10 anticipated on the following schedule:

- 11 • Draft Environmental Assessment/Initial Study (EA/IS) for Arroyo Canal  
 12 Screening and Sack Dam Passage was released on June 1, 2012
- 13 • Final EA/IS for Arroyo Canal Screening and Sack Dam Passage is anticipated to  
 14 be released in October 2012

### 15 **3.8.1 Actions**

16 Specific actions identified in the *Working Draft Framework for Implementation* (SJRRP,  
 17 2012b) associated with the structural improvements identified above include the  
 18 following:

- 19 • **Chowchilla Bifurcation Structure Passage** – This would include constructing a  
 20 fish ladder or ramp. Water velocities at the existing structure are expected to  
 21 exceed fish passage criteria during flood flows and create an impediment to adult  
 22 passage.
- 23 • **San Joaquin River Control Structure Passage** – This would include  
 24 constructing a fish ladder or ramp on the existing structure or replacing the  
 25 structure as part of water supply facilities for the Mendota Pool. Hydraulic  
 26 analysis indicates that water velocities during flood flows would exceed criteria  
 27 for adult Chinook salmon passage at the existing structure.
- 28 • **Arroyo Canal Screening and Sack Dam Passage** – This would include  
 29 constructing a fish screen on the Arroyo Canal and passage facilities at Sack Dam.  
 30 Arroyo Canal was identified as very likely to entrain a large proportion of  
 31 juvenile salmon. Screening the canal would prevent this loss. Sack Dam has  
 32 been identified as a passage barrier for adult salmon when the boards are in place.  
 33 The drop height of over 2.5 feet in the spring would impede upstream passage.
- 34 • **Eastside Bypass Control Structure Passage** – This would include constructing a  
 35 fish ladder or ramp. Excessive velocities at the existing structure during flood  
 36 flows exceed the fish passage criteria and impede adult upstream migration.
- 37 • **Mariposa Bypass Control Structure Passage** – This would include constructing  
 38 fish passage in coordination with a drop structure and low-flow channel

1 modifications. Excessive velocities at the existing structure exceed fish passage  
2 criteria maximums and would impede upstream adult migration.

3 • **Mariposa Bypass Drop Structure Passage** – This would include constructing  
4 passage in coordination with a control structure and low-flow channel  
5 modifications. This drop structure is an adult fish passage impediment at all flow  
6 levels. Modification or removal will allow fish to pass.

7 • **Mendota Pool Bypass** – The Mendota Pool is a potential major source of  
8 juvenile salmon loss through entrainment into water diversions in most years.  
9 Bypassing fish around the Mendota Pool, modifying the structure, or moving the  
10 Mendota Pool into Fresno Slough would resolve this concern.

11 Additional actions have not been implemented, but the Implementing Agencies are  
12 developing plans for these actions. These actions are identified in the *Working Draft*  
13 *Framework for Implementation* (SJRRP, 2012b) by the Implementing Agencies include  
14 the following:

15 • **San Mateo Road Crossing** – The San Mateo Avenue road crossing was  
16 identified as a potential adult migration impediment, but it is uncertain how  
17 significant this barrier is for adult passage. At high flows, adult passage is not  
18 expected to be impaired, but it uncertainty exists regarding passage impacts and  
19 how monitoring should be implemented to determine the degree to which the  
20 existing crossing would delay or impede fish passage.

21 • **Chowchilla Bypass Passage at Crossings**

22 – **Avenue 18 ½** – Fish are expected to migrate up the Chowchilla Bypass during  
23 flood flows, and may encounter this crossing. Hydraulic analysis indicates a  
24 high elevation drop. Modifying this crossing would increase confidence about  
25 the ability of fish to migrate through the bypass under flood conditions.

26 – **Avenue 21** – Fish are expected to migrate up the Chowchilla Bypass during  
27 flood flows, and may encounter this crossing. Hydraulic analysis indicates a  
28 high elevation drop. Modifying this crossing would increase confidence about  
29 the ability of fish to migrate through the bypass under flood conditions.

30 • **Eastside Bypass Passage at Crossings and Structures**

31 – **Dan McNamara Road** – This road crossing could potentially impact adult  
32 migration, but it is not believed to completely impede upstream passage.

33 – **Merced National Wildlife Refuge Weirs** – The Merced Refuge weir can  
34 present a vertical drop barrier for upstream migrating salmon under low- to  
35 moderate-flow conditions. This barrier is expected to be more of a passage  
36 impediment for fall-run Chinook salmon because they will migrate at lower

1 flows than spring-run Chinook salmon in most years. Operation of the weir,  
2 such as removing the flashboards, may resolve this impediment.

3 The schedule for implementing the actions is presented in Figure 2-1. The Implementing  
4 Agencies identified other actions as potential improvements:

- 5 • King's River Fish Barrier (Reach 2B)
- 6 • Washington Avenue Bridge Replacement (Reach 4B)
- 7 • Turner Island Road Bridge Replacement (Reach 4B)
- 8 • El Nido Road Crossing Passage (Eastside Bypass)
- 9 • Chamberlain Road Crossing (Eastside Bypass)
- 10 • Mariposa Bypass Road Crossing (Bypass)
- 11 • Newman Wasteway Barrier (Reach 5)
- 12 • Other Barriers (Reach 5)

### 13 **3.8.2 Questions**

14 <To be included in final 2013 MAP.>

### 15 **3.8.3 Studies**

16 Studies planned for implementation in 2013 addressing fish passage issues include the  
17 following:

- 18 • Adult Passage (Study 20, Appendix A)
- 19 • Adult Passage – Nonstructural Passage Impediments (see Study 12, Appendix A,  
20 2012 MAP, for complete study)
- 21 • Trap and Haul of Adult Fall Run Chinook (Study 6, Appendix A)

#### 22 **3.8.3.1 Adult Passage**

23 This study is working to develop conceptual alternatives to improve conditions on the  
24 river to allow for unimpeded fish passage for the entire Restoration Area and will  
25 recommend fish passage improvements by developing alternative solutions at structures  
26 that have been identified as potential fish barriers. This work will be completed during  
27 2013. The focus fish for the evaluation will be adult Chinook salmon, but can include  
28 other fish species if there is evidence that they will be present at the structure and will  
29 need passage.

1 **3.8.3.2 Adult Passage - Nonstructural Passage Impediments (see Study 12,**  
2 **Appendix A, 2012 MAP for complete study)**

3 In addition to structural impediments, adult migration may be impeded by shallow water  
4 conditions, unidentified shallow water crossings, and water quality conditions (e.g.,  
5 temperature). A study is currently underway to identify these nonstructural passage  
6 barriers. Previous years' efforts have focused on evaluating conditions through  
7 hydrologic models. This effort will incorporate field monitoring of sites that were  
8 identified as possible adult passage impediments. If the report identifies potential  
9 passage impediments that could limit meeting SJRRP objectives, the SJRRP may elevate  
10 potential projects or manage flow levels for passage conditions.

11 **3.9 Fish Reintroduction**

12 The Implementing Agencies will conduct a series of efforts to further understand the  
13 reintroduction process through developing a captive Chinook salmon broodstock,  
14 conducting expanded studies to address key uncertainties, and implementing pilot  
15 Chinook salmon release efforts to test and refine strategies. Starting in 2010, fall-run  
16 broodstock were collected and raised in the Interim Facility to refine captive rearing  
17 techniques. Experimental studies were initiated in spring 2012 with juvenile study fish  
18 from the Feather River Hatchery on the SJR.

19 The SJRRP is preparing for returning adults by setting up a trap and haul operation in  
20 Reach 5 for fall 2012. Trap and haul programs have been used in other systems to allow  
21 fish passage before resolving all fish passage impediments (Zimmerman, 1996).  
22 Returning adults would be trapped and transported to upstream areas. Low numbers of  
23 adult returns are expected from the initial releases, which will allow fish to be actively  
24 captured and transported. The Implementing Agencies can begin testing a trap, haul, and  
25 release program before the return of SJRRP released fish by relying on fall-run Chinook  
26 salmon from San Joaquin River tributaries that stray into the Restoration Area.

27 **3.9.1 Actions**

28 Actions to improve understanding of the fish reintroduction process include preparing for  
29 a spring-run broodstock program, trap and haul of fall-run adults above the Hills Ferry  
30 Barrier, translocation of eggs or juveniles from the Feather River Hatchery to the SJR,  
31 and a continuation of a fall-run Chinook salmon broodstock experiment.

32 Trap and haul actions would involve moving adult fish and eventually juvenile fish  
33 around passage barriers. A number of passage barriers exist within the Restoration Area.  
34 Fish released into the system prior to these passage issues being completely resolved will  
35 involve assistance to reach suitable rearing, holding, and spawning habitat. Trap and haul  
36 operations have been used in other systems to provide salmon passage around  
37 impoundments and other barriers to allow fish releases before resolving all passage  
38 issues.

39 **3.9.2 Questions**

40 <To be included in final 2013 MAP.>



### 1 **3.9.3 Studies**

2 Three studies planned for implementation in 2013 focus on addressing uncertainties  
3 associated with fish reintroduction. Results from these studies will inform the  
4 Implementing Agencies on whether there is sufficient habitat quantity and quality for  
5 reintroduction under a successful program. The studies include the following:

- 6 • Captive Rearing Study (Year 3) (Study 12, Appendix A)
- 7 • Juvenile Salmon Holding (Study 7, Appendix A)
- 8 • Trap and Haul of Adult Fall-Run Chinook (Study 6, Appendix A)

#### 9 **3.9.3.1 Captive Rearing Study (Year 3)**

10 The goal of the Captive Rearing Study is to continue to investigate methods for the  
11 captive rearing of Chinook salmon from spawning through adulthood in an effort to be  
12 fully prepared to work with threatened spring-run Chinook and to increase the chances  
13 for successfully developing a self-sustaining, self-reproducing population of spring-run  
14 Chinook salmon in the SJR. The SJRRP *Fisheries Implementation Plan* (SJRRP, 2010a)  
15 prioritized studies to address information needs for fish restoration and identified the  
16 Fall-run Captive Rearing Study as a high priority before spring-run Chinook salmon are  
17 reintroduced, which is required by the Settlement by December 31, 2012. The study is  
18 also identified as instrumental in the SJRRP *Hatchery and Genetic Management Plan*  
19 (SJRRP, 2010b), which was submitted to the National Oceanic and Atmospheric  
20 Administration (NOAA) NMFS as an Appendix to the 10(a)1(A) Enhancement of  
21 Species permit application (USFWS, 2011).

22 This study is in the third year of a 4-year program; the objectives of the program change  
23 annually.

#### 24 **3.9.3.2 Juvenile Salmon Holding**

25 The juvenile salmon holding study is a critical component of salmonid reintroduction  
26 efforts. Whether reintroduction in 2012/2013 involves spring-run or fall-run Chinook  
27 salmon, either are likely to be held in the SJR until they are large enough to be tagged so  
28 that they can be identified as SJRRP stocks for numerous regulatory reasons. Further,  
29 juveniles held in this study are likely to be used to support other studies evaluating site-  
30 and reach-specific survival and movement rates.

31 Data collected over the life of the study will be used to determine if out-of-basin juvenile  
32 salmon can imprint on, and will return as adults to, the SJR after being held for at least 10  
33 days. This will inform future reintroduction strategy decisions. Rotary screw trap  
34 operations will also lay the foundation for long-term monitoring to inform future  
35 decisions about reintroduction, population management, water operations, and restoration  
36 activities.

#### 37 **3.9.3.3 Trap and Haul of Adult Fall Run Chinook**

38 This study will involve trapping salmon in Reach 5 and relocating the salmon to Reach 1  
39 of the Restoration Area. Field activities associated with this study will include

1 transporting adult Chinook salmon around existing barriers in the SJR to suitable holding  
2 and spawning habitat and developing protocols to successfully trap and haul adult  
3 salmon.

4 The objectives associated with this study include assessing the viability of trapping and  
5 hauling adult salmon, assessing spawning site selection of adults transported to Reach 1,  
6 and establishing a long-term plan for using trap and haul activities.

### 7 **3.10 Water Management**

8 Water Management Goal actions include identifying, developing, and implementing  
9 projects and programs to reduce or avoid adverse water supply impacts to all of the Friant  
10 Division long-term contractors that may result from the Interim and Restoration flows  
11 provided for in the Settlement. The reduction in water deliveries caused by the Interim  
12 and Restoration flows is monitored and recorded in the Recovered Water Account  
13 (RWA). The SJRRP prioritizes and measures the success of actions by their ability to  
14 reduce RWA balances of Friant Division long-term contractors.

15 The Implementing Agencies identified actions in the *Working Draft Framework for*  
16 *Implementation* (SJRRP, 2012b) associated with water management to include Friant-  
17 Kern and Madera Canals Capacity Restoration; Part III, Recapture, Recirculation, and  
18 Other Projects; Outreach and Technical Support; and Investment Strategy Development.  
19 Reclamation, in coordination with appropriate Federal, State of California (State),  
20 regional, and local authorities, is authorized and directed to conduct feasibility studies on  
21 restoring the capacity of the Friant-Kern and Madera canals to such capacity as  
22 previously designed and constructed by Reclamation. After completion of, and  
23 consistent with, the applicable feasibility study, Reclamation is authorized to construct  
24 improvements and facilities in accordance with applicable Federal and State laws.  
25 Initially, Reclamation jointly evaluated restoration of the capacities of the Friant-Kern  
26 and Madera canals. However, because of unique differences in the design and  
27 construction of the canals, Reclamation has since separated the evaluation into two  
28 separate feasibility studies.

## 1 **4.0 Environmental Compliance**

2 SJRRP actions are subject to environmental compliance. This section provides an  
3 overview of the environmental documents and permits that affect implementation of the  
4 SJRRP. These requirements are taken into consideration when developing and  
5 performing monitoring and analysis activities to support the SJRRP. The data collected  
6 through this mandatory monitoring and analysis may be used to address other SJRRP  
7 uncertainties. The SJRRP reports this data on an annual basis in the ATR.

### 8 **4.1 Final Program Environmental Impact Statement/Report**

9 The Final SJRRP PEIS/R (SJRRP, 2012a) contains a Conservation Strategy with  
10 elements to be incorporated into projects to avoid or minimize adverse effects to listed  
11 species. To meet the Conservation Strategy goals of controlling and managing invasive  
12 species and conserving special-status species, monitoring and analysis will be performed  
13 to establish baseline species presence in the Restoration Area, and to design more specific  
14 protective measures.

### 15 **4.2 Central Valley Steelhead Monitoring Plan**

16 As part of the Water Year 2010 through Water Year 2012 Interim Flows projects,  
17 Reclamation committed to a Central Valley Steelhead Monitoring Plan. Spring Interim  
18 Flows occurring from February 1 through June 1 could attract adult steelhead into the  
19 Restoration Area. Attracted steelhead would not have access to appropriate spawning  
20 habitat because of a number of impassable barriers. Reclamation, in coordination with  
21 the Fisheries Management Work Group, has proposed a Steelhead Monitoring Plan to  
22 facilitate detection of steelhead on the SJR upstream from the Merced River confluence  
23 and to transport to suitable habitats downstream from the mouth of the Merced River.

24 This study is a multi-year study and will implement monitoring activities during 2013 for  
25 Central Valley Steelhead in the Restoration Area (Study 14, Appendix A).

### 26 **4.3 State Water Resources Control Board Water Rights** 27 **Orders**

28 On October 1, 2009, the State Water Resources Control Board (State Board) issued Order  
29 2009-058-DWR for the Water Year 2010 Interim Flows Project. Order 2009-058-DWR  
30 required explicit monitoring during implementation of Water Year 2010 Interim Flows.  
31 These requirements included monitoring flow, water quality, seepage, and invasive  
32 species, consistent with the MMPs and the *Water Quality Monitoring and Quality*  
33 *Assurance Plan* identified in the Water Year 2010 Interim Flows Project EA/IS

1 (Reclamation, 2009). Order 2009-058-DWR further required monitoring of water quality  
2 and sediments at several locations along the river, beginning in fall 2009. Order 2009-  
3 058-DWR also required Reclamation to develop a monitoring plan, acceptable to the  
4 Deputy Director for Water Rights, for releases that began after February 1, 2010.

5 Reclamation developed the *2009 – 2013 Interim Flows Release Program Water Quality*  
6 *Monitoring Plan* in January 2010, in part to meet the water quality and bed sediment  
7 monitoring requirements of Order 2009-058-DWR. According to the plan, the core of  
8 SJRRP monitoring includes a series of sensors along the SJR that will make continuous  
9 measurements of physical conditions, including flow, depth, temperature, specific  
10 conductance (salinity), pH, DO, turbidity, and chlorophyll. Raw data are posted by the  
11 California Data Exchange Center (CDEC) ([www.cdec.water.ca.gov](http://www.cdec.water.ca.gov)) and linked to the  
12 SJRRP Web site.

13 On September 30, 2010, the State Board issued an order for the Water Year 2011 Interim  
14 Flows Project. Order 2010-029-DWR states that Reclamation is required to continue  
15 implementing the 2009–2013 *Interim Flows Release Program Water Quality Monitoring*  
16 *Plan* and a water quality response plan. Order 2010-029-DWR requires Reclamation to  
17 submit requests to modify the *Interim Flows Release Program Water Quality Monitoring*  
18 *Plan* in writing to the Deputy Director for Water Rights; modifications may only be made  
19 upon written approval of the Deputy Director for Water Rights. Order 2010-029-DWR  
20 required Reclamation to develop and submit to the Deputy Director for Water Rights, by  
21 February 1, 2011, a Water Quality Response Plan completed to address the following: (1)  
22 contribution of Interim Flows to high salinity conditions in the Delta-Mendota Canal,  
23 Mendota Pool, and Fresno Slough, (2) an identification of the different entities and  
24 individuals who may contribute to or play a role in the response to high salinity  
25 conditions, (3) the current legal and contractual roles and responsibilities of those entities,  
26 and (4) possible mechanisms, including those under the control of Reclamation and those  
27 that are the responsibility of other entities and individuals. Order 2010-029-DWR also  
28 stated that Reclamation is required to implement monitoring of temperature changes in  
29 Millerton Reservoir and to implement a schedule for ramping flow releases, consistent  
30 with the Settlement.

31 For Water Year 2012, the State Board approved the temporary transfer of water and  
32 change petitions filed on July 28, 2011, pursuant to Water Code sections 1725 and 1707  
33 for Permits 11885, 11886 and 11887. A long-term petition is anticipated to be in place in  
34 2013 that may require some modifications.

## 1 **5.0 Monitoring Network**

2 The SJRRP maintains a network of installed monitoring equipment and permanent survey  
3 locations to meet Settlement requirements and environmental commitments, and to  
4 collect relevant data during Interim Flows. This section presents changes to the  
5 monitoring network scheduled for 2013 to promote integration of all sensors and to  
6 disclose available data. Existing infrastructure is documented in resource-specific  
7 monitoring plans and atlases.

8 The monitoring network is continually refined to meet the evolving information needs of  
9 the SJRRP. Table 5-1 presents monitoring network installations planned for 2013, and  
10 Table 5-2 presents monitoring network surveys planned for 2013.

11 Data collected from the monitoring network are presented in the MYTR and ATR  
12 annually. Real-time data available from flow gage stations are available through CDEC  
13 and can be accessed through links on the SJRRP Web site (<http://restoresjr.net>).  
14 Groundwater levels from select wells and water quality measurements from telemetered  
15 stations are also available in real-time and are accessible on the SJRRP Web site. The  
16 data collected from the SJRRP monitoring network will be analyzed in studies to support  
17 SJRRP implementation and management actions.

**Table 5-1.  
Monitoring Equipment Installation**

<b>Monitoring Stations/Sites</b>	<b>2013 Plans</b>	<b>Relevant Study Name</b>
Temperature	New monitoring locations may be included pending flow conditions (available on the SJRRP Web site at <a href="http://restoresjr.net">http://restoresjr.net</a> ).	Temperature Monitoring for Adult Migration
PIT tag arrays	Two additional structure arrays may be designed and constructed.	San Joaquin River PIT Tag Monitoring and Site-Specific Technology Development (Reclamation, USFWS)
Hydrophone and quadraphone stations	Five stereo hydrophone stations and one quadraphone station will be installed on the San Joaquin River, Little Dry Creek, and two riffles.	Continuous Surrogate Measurement of Bedload Sediment Transport Using Hydrophone Installations on the San Joaquin River, California (USGS)
Water-level recorders	Recorders will be added or relocated as identified based on data needs	Additional Water Level Recorders (DWR)
Groundwater monitoring wells	Thirty-four proposed wells will be installed.	Monitoring Well Network Optimization (Reclamation)
Levee drilling	Drilling will begin in late 2012 and continue in 2013.	Levee Geotechnical Exploration (DWR)

Key:

DWR = California Department of Water Resources

MAP = Monitoring and Analysis Plan

PIT = passive integrated transponder

Reclamation = U.S. Department of the Interior, Bureau of Reclamation

SJRRP = San Joaquin River Restoration Program

USFWS = U.S. Fish and Wildlife Service

USGS = U.S. Geological Survey

**Table 5-2.  
Monitoring Network Surveys**

<b>Survey Type</b>	<b>Purpose</b>	<b>2013 Plans</b>	<b>Relevant Study Name</b>
Water surface profiles	Hydraulic model calibration	No water surface profile surveys planned for 2013.	Surface Water Profile Surveys and Discharge Measurements (DWR)
Bathymetric	Hydraulic model calibration	No bathymetric surveys planned for 2013.	
Cross sections	Hydraulic model calibration	Resurveys to be conducted only if flows reach a range expected to significantly change bed topography.	Monitoring Cross-Section Resurveys (DWR)
Aerial	Inundation mapping, habitat assessments, vegetation mapping	No aerials planned for 2013.	Not applicable
Vegetation	Model calibration, detection of invasive species, riparian recruitment information.	Annual vegetation surveys planned for 2013.	Not applicable
Bed material sampling	Hydraulic model calibration	No bed material sampling planned for 2013.	Bed Material Data Collection (Reclamation), DWR studies.
Invertebrate studies	Habitat assessment	Sampling to be completed by early fall 2012. Refined bioassessment techniques will be applied in the bypass system.	Benthic Macroinvertebrate SWAMP Bioassessment (DWR, DFG)

Key:

DFG = California Department of Fish and Game

DWR = California Department of Water Resources

MAP = Monitoring and Analysis Plan

Reclamation = U.S. Department of the Interior, Bureau of Reclamation

SWAMP = Surface Water Ambient Monitoring Program

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## 6.0 Analytical Tools

This section discloses the analytical tools currently available or under development for the SJRRP (Table 6-1). These tools can be used to help meet study goals, and to simulate additional action that need to take place to promote successful implementation of the Settlement.

Analytical tools provide a numerical representation of conceptual models. Monitoring data collection for the SJRRP can improve calibration and validation of these tools and fill in physical data gaps.

**Table 6-1.  
Analytical Tools for SJRRP**

Model	Type	Purpose	Status	Model Application
DTM	Terrain	Digital terrain model of San Joaquin River	Complete with exception of incorporating 2011 gravel pit surveys for Reach 1A	Support other model development/updates
HEC-RAS	Hydraulic (1D)	Water surface (Inundation mapping)	Completing mapping review and incorporating updated bathymetry for steady-state model	Support Reach 4B pit study: includes refined model with vertical N values and original model with horizontal N values
SRH-2D	Hydraulic	Depth/velocity/habitat mapping	Existing conditions model available; some reaches modified to evaluate alternatives (Reclamation, 2008)	Support floodplain rearing study
SRH-2D	Sediment	Transport/habitat mapping	Finishing modeling and analyzing results	Analyze sediment deposition dynamics at bypass in Reach 2A.
SRH-2D	Temperature	Habitat mapping	Temperature model will be updated in 2013 (see Study 19)	Test temperature in model gravel pits in Reach 2B
SRH-1D	1D mobile boundary sediment	Transport	Geometry to be updated	Support Reach 2B study proposed alignments
HEC-5Q	1D hydraulic routing, temperature	San Joaquin River temperature	Complete (Reclamation, 2007)	Modeling for proposed hydrographs to aid flow scheduling
CE-QUAL-W2	Temperature (vertical 2D)	Millerton Lake cold water pool	Complete (Portland State University, 2012)	Simulate cold water pool in Millerton Lake
SRH-1DV	Cross section vegetation	Vegetation response to flow and sediment conditions	Geometry to be updated	Support design work on Reach 2B and Reach 4B site-specific projects

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**Table 6-1.  
Analytical Tools for SJRRP (contd.)**

<b>Model</b>	<b>Type</b>	<b>Purpose</b>	<b>Status</b>	<b>Model Application</b>
CVHM	Groundwater	Groundwater flow	Complete (USGS, 2012)	Run preliminary simulations related to Reach 2B proposed alignments
EDT	Fisheries	Population response to habitat conditions	Under refinement	Run preliminary simulations related to Reach 2B proposed alignments
ESHE	Fisheries	Floodplain habitat	Under development	Identify floodplain habitat needs for salmon

Key:

1D = one-dimensional

2D = two-dimensional

CVHM = Central Valley Hydrologic Model

DTM = Digital Terrain Model

EDT = Ecosystem Diagnosis and Treatment

ESHE = Emigrating Salmonid Habitat Estimation

HEC = Hydrologic Engineering Center

RAS = River Analysis System

SJRRP = San Joaquin River Restoration Program

SRH = Sedimentation and River Hydraulics

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# 1 7.0 Monitoring Activities Summary

2 This section lists what type of monitoring activities are going to occur in 2013, and can  
 3 be used to help coordinate efforts among agencies to efficiently collect relevant data to  
 4 implement the SJRRP. Table 7-1 summarizes the schedule for monitoring activities in  
 5 2013. Study numbers below reference Appendix A study sections. The budget for the  
 6 2013 studies is presented in Appendix C. Attachment 1 presents a table identifying  
 7 studies presented in the 2012 MAP and the status of those studies.

8 **Table 7-1.**  
 9 **Monitoring Activities Summary**

2013 MAP Appendix A Study	Study	Monitoring	Schedule/Frequency
1	Flow Gage Record Analysis	Surface water	Continuous
2	Lateral Gradient of Water Table	Surface water, groundwater, soil monitoring, and tile drain system flow	Continuous
3	Changes in Soil Salinity Conditions Resulting from Interim Flows	Soil salinity	On as-needed basis
4	Influence of Paleochannels on Seepage	Seepage	June through September 2012
5	Temperature Monitoring of Cold Water Pool in Millerton Lake	Reservoir temperature	Continuous
6	Trap and Haul of Adult Fall Run Chinook	Fisheries	October 2012 to 2020
7	Juvenile Salmon Holding	Fisheries	Spring 2013
8	Egg Survival (Fall 2012)	Water quality, sedimentation, and hydraulics	Mid-September 2012 through January 2013
9	Fish Assemblage Inventory and Monitoring	Fisheries	Annual
10	Juvenile Salmonid Migration and Survival (Year 3 – Telemetry)	Fisheries	Start spring/early summer of 2013
11	Assessment of Predator Abundance and Distribution in Mine Pit Habitat in the San Joaquin River Restoration Area	Fish tagging and stomach analysis, surface temperature, DO, and turbidity	One week each month January 2013 through June 2013
12	Captive Rearing Study (Year 3)	DO, temperature, and feed quantity Fish weights, lengths, and condition factors will be measured	Daily Every 2 to 3 months
13	Levee Geotechnical Exploration	Drilling	Summer 2012 through summer 2013

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**Table 7-1.  
Monitoring Activities Summary (contd.)**

<b>2013 MAP Appendix A Study</b>	<b>Study</b>	<b>Monitoring</b>	<b>Schedule/Frequency</b>
14	Central Valley Steelhead ( <i>Oncorhynchus mykiss</i> ) Monitoring Plan for the San Joaquin River Restoration Program	Electrofishing Fyke nets with wing walls and traps Trammel nets	Monthly during December through March 2013 Mid-December through March 15, 2013 December through March 2013
15	San Joaquin River PIT Tag Monitoring and Site-Specific Technology Development	PIT tag arrays	Maintained for 6 – 8 weeks in spring 2013
16	Floodplain Quality	Habitat field work	March and April 2013
17	Bed Material Data Processing and Evaluation	Sediment	Data collection complete
18	Continuous Surrogate Measurement of Bedload Sediment Transport Using Hydrophone Installations on San Joaquin River, California	Bed topography	Continuous
19	Two-Dimensional Temperature Monitoring of Gravel Pits in Reach 1A	Modeling	Not applicable
20	Adult Passage	Fisheries	January through March 2013
21	USGS Sediment Monitoring	Sediment	Every other week during February through June
22	USGS San Joaquin River Tributary Sediment and Geomorphology Study	Sediment and Geomorphic	Winter 2012 and spring 2013
23	Vegetation Monitoring	Vegetation	5 days between June and August
24	Additional Water Level Recorders	Surface water	Continuous
25	Monitoring Cross-Section Resurveys	Bed Topography	Only if flows are sufficient to move bed material
26	Effect of Altered Flow Regime on Channel Morphology in Reach 1A	Topography	Data collection to continue in collaboration with egg survival study.
27	Effect of Scour and Deposition on Incubation Habitat in Reach 1A	Fisheries	November and December 2012
28	Reach 1A Spawning Area Bed Mobility	Bed Topography	Data collection complete
29	Thermal Conditions in Riverine Pools	Temperature, Pressure, Conductivity	July to August 2012 at 15 minute intervals

## Key:

DO = dissolved oxygen

MAP = Monitoring and Analysis Plan

PIT = passive integrated transponder

## 1 8.0 Conclusions

2 At the end of 2013, the SJRRP expects to have progressed on addressing the uncertainties  
3 for actions within each theme through completion of study questions and redevelopment  
4 of new pathways to address uncertainties. The following section is organized by theme  
5 and summarizes anticipated outcomes of 2013 monitoring and analysis activities.

- 6 • **Flow Management** – Refined approach to flow scheduling incorporating input  
7 from cold water pool management; Fisheries Management Work Group regarding  
8 fisheries temperature needs during different periods of the year and juvenile  
9 responses to pulses; continued flow gage record analysis to identify any trends in  
10 losses from Friant Dam to Gravelly Ford; and updated reports of recapture  
11 accounting.
- 12 • **Conveyance** – Completion of levee geotechnical evaluations and initiation of  
13 revisions to channel capacity constraints at the beginning of 2014; Draft EIS/R for  
14 both the Reach 2B Channel Capacity Improvements, and Reach 4B, Eastside  
15 Bypass, and Mariposa Bypass Conveyance site-specific projects; updated  
16 thresholds for *Seepage Management Plan* (SJRRP, 2011); additional  
17 groundwater, soil salinity, and soil texture data to inform design of seepage  
18 projects to improve SJRRP flow conveyance.
- 19 • **Entrainment Protection** – Identification of locations with entrainment issues in  
20 addition to those already identified in site-specific projects to understand fish  
21 survival.
- 22 • **Adult Migration Paths** – Understanding of adult migration patterns under  
23 existing conditions using data collected from trapping upstream from the Hills  
24 Ferry, China Island, and Mud Slough and Salt Slough barriers.
- 25 • **Fish Passage** – Understanding of sturgeon occurrence, passage routes, upstream  
26 migration extent, annual timing, and habitat preferences in the Restoration Area to  
27 inform site-specific fish passage structural designs; identify any nonstructural  
28 passage impediments not addressed in the structural improvement projects.
- 29 • **Predation** – Understanding of predation risk through measuring predator  
30 abundance near the gravel mine pits and juvenile survival in the Restoration Area.
- 31 • **Rearing Habitat** – Development of methods to estimate floodplain habitat  
32 quality for juvenile salmon and better understanding of trade-offs among different  
33 floodplain management options.
- 34 • **Spawning and Incubation** – Understanding of relationship between Friant Dam  
35 releases and gravel water quality conditions (for the range of flows released in fall  
36 2012) for spawning and incubation in Reach 1A.

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- **Fish Reintroduction** – Preparation for a spring-run Chinook salmon broodstock program, a trap and haul of fall-run adults above Hills Ferry Barrier, translocation of eggs or juveniles from the Feather River Hatchery to SJR, and continuation of a fall-run Chinook salmon broodstock experiment.

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## 9.0 References

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