

CHAPTER 12. OTHER PROGRAMS, DOWNSTREAM OPPORTUNITIES AND CONSTRAINTS

12.1. INTRODUCTION

Previous chapters have described numerous critical issues associated with restoration in the study reach from Friant Dam to the Merced River confluence. However, the San Joaquin River does not end at the Merced River, and additional issues in the portion of river downstream of the Merced River confluence, as well as in the Bay-Delta region, must also be addressed. The restoration of the San Joaquin River must ultimately integrate with activities and programs downstream of the Merced River confluence (Figure 12-1). This is no easy task, and is made more difficult by (1) the multitude of existing programs, some with conflicting stakeholder interests and agendas, and (2) by the current degraded environmental conditions of the lower San Joaquin River, a 120-mile reach extending downstream of the junction with the Merced River to Vernalis (Figure 12-1). The upper and lower portions of the San Joaquin River are obviously linked however, and for the upper San Joaquin River restoration program to succeed, conditions in the lower San Joaquin River must be favorable as well.

In many ways, this linkage creates opportunity. In addition to improving environmental conditions in the study area, restoration actions will dramatically benefit the downstream river ecosystem, including the three major tributaries to the lower San Joaquin River. For example, by adding a “fourth” fall-run Chinook salmon spawning population in the San Joaquin basin, risks associated with low escapements during drought years could be greatly reduced. Also, additional streamflow to help convey salmonid smolts through the study reach will benefit salmon produced in other rivers as well as those from the San Joaquin River. Other opportunities for improving environmental conditions include expanding low-lying, flood-prone grasslands and wildlife refuges to improve flood management, water supply, and water and habitat quality along the lower San Joaquin River, and improving lower San Joaquin River and Delta rearing habitat for juvenile Chinook salmon.

With these opportunities come additional complexities. The purpose of this chapter is to consider opportunities and constraints provided by the lower San Joaquin River that will affect restoration efforts in the upper San Joaquin River, and to discuss how current programs and plans on the lower San Joaquin River will eventually affect programs and plans of the upper San Joaquin River. To better clarify our references to the different reaches of the San Joaquin River, the study area from Friant Dam to the Merced River is referred to as the “upper” San Joaquin River, and the reach outside the study area downstream of the Merced River is referred to as the “lower” San Joaquin River (Figure 12-1). This distinction is made only in this chapter.

12.2. OBJECTIVES OF THIS CHAPTER

The objectives of this chapter are to:

- Describe and evaluate other existing or planned State, Federal, regional, and local programs and regulations (including flood control regulations) that currently affect or will affect the management of the San Joaquin River or that would provide additional information on San Joaquin River ecosystem functioning.
- Discuss “downstream” opportunities and constraints for improved flood management, water supply, water quality, and habitat improvement, from the Merced River confluence to Sherman Island in the South Delta.

12.3. STUDY AREA

The geographic focus is different for each of the two chapter objectives. For the “other programs” objective, the focus is on the entire San Joaquin River basin and includes the numerous State and Federal resource agencies with regulatory jurisdiction or policy management for the San Joaquin basin. Several of the programs discussed, such as the CALFED Bay-Delta Program (CALFED), have a much broader area of concern than just the San Joaquin River basin. We have tried to present material for these programs as they specifically relate to the San Joaquin River Restoration Program.

In assessing downstream opportunities and constraints, the study area is focused downstream of the Merced River, and generally includes two distinct ecological zones: the approximately 50 miles of lower San Joaquin River where the Merced, Tuolumne, and Stanislaus rivers join the San Joaquin River, and the South Delta, from approximately the head of Old River downstream to Sherman Island, where the San Joaquin River joins the Sacramento River (Figure 12-1).

12.4. OTHER PROGRAMS

The Sacramento-San Joaquin River Delta is a key region within California for water supply and water quality, and it is also critically important to numerous plant, fish and wildlife species that either inhabit the Delta or use the Delta seasonally. For these reasons, several large regulatory programs and much attention has focused on this region, particularly in the last several decades. In assessing these other programs, we offer two caveats. First, we have not attempted to discuss in detail how each of these programs will integrate with efforts to restore the San Joaquin River. Integrating this Restoration Study with existing programs will be the responsibility of the San Joaquin River Restoration Program. Second, with a river as large and complex as the San Joaquin, considering all programs, big and small, is impossible. We have included only the major regulatory or stakeholder programs that currently have or eventually will have a direct involvement in restoration of the San Joaquin River.

Several existing programs within the Central Valley and the Bay-Delta region may offer substantial opportunities for cooperation or integration with this Restoration Study. Components of the CALFED and Central Valley Project Improvement Act (CVPIA) programs, for example, should be integrated with the San Joaquin River Restoration Program.

12.4.1. CALFED

The CALFED Bay-Delta Program (CALFED) was formed in 1995 as a cooperative effort among 23 State and Federal agencies that manage and regulate the Sacramento–San Joaquin River Delta (Delta). The mission of CALFED is to develop and implement a long-term comprehensive plan that will restore ecological health and improve water management for beneficial uses of the Bay-Delta. CALFED is focusing on long-term measures to address problems affecting the Bay-Delta estuary and surrounding watersheds.

In August 2000, the program concluded a five-year planning phase, during which the program: (1) expanded from its original mission to include 11 major program elements, (2) developed and finalized a programmatic environmental document (EIS/EIR), (3) established a Science Program, and (4) received signature on the Record of Decision (ROD). CALFED is now moving forward to implement the ROD, with Stage-1 implementation planned to occur over the next seven years.

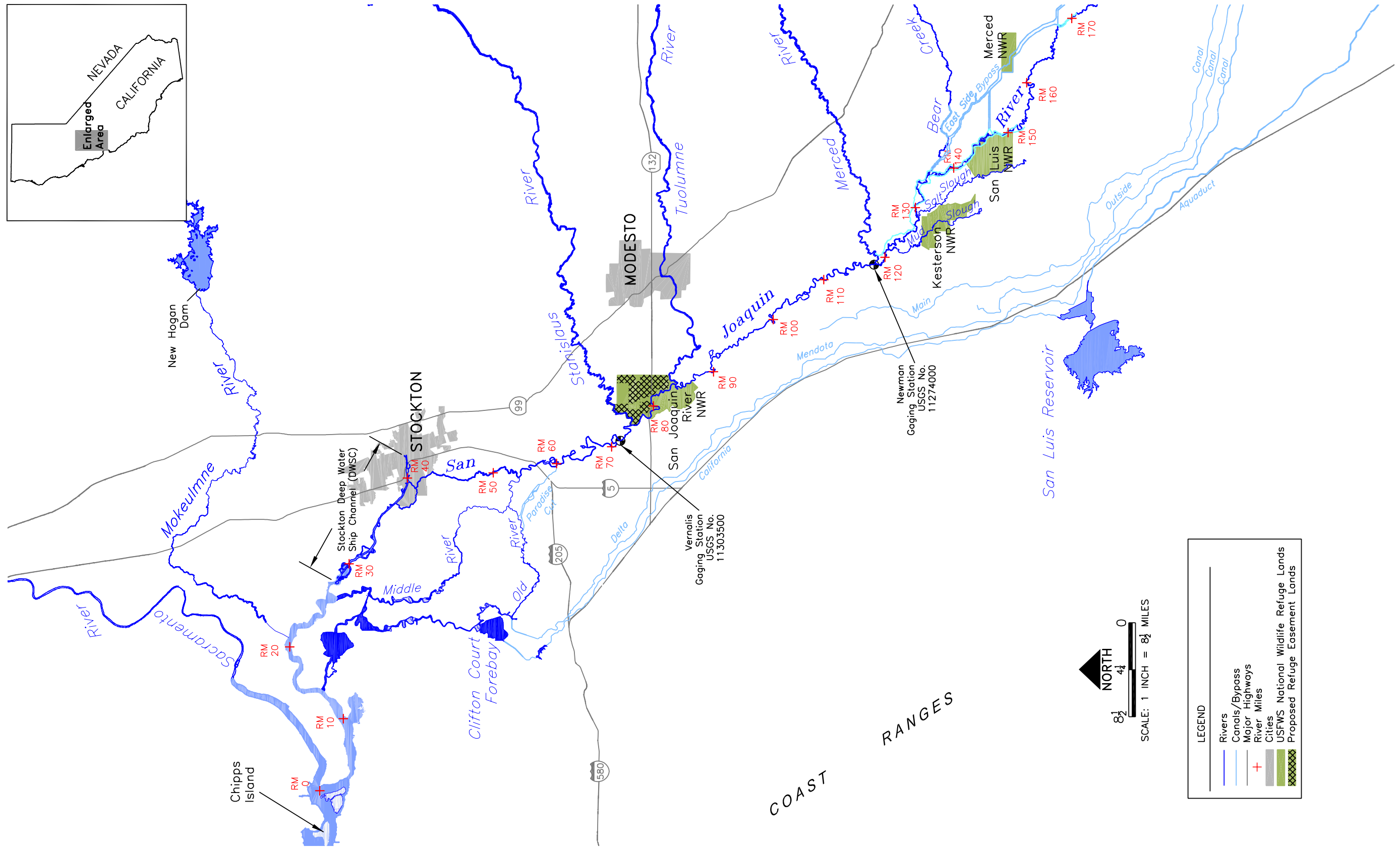


Figure 12-1. Location map for the San Joaquin River.

While the upper San Joaquin River was not among the CALFED Ecological Management Zones, CALFED has nevertheless been involved in the entire San Joaquin River basin, and has continually expanded its role in the basin. Specifically relating to upper San Joaquin River Restoration Program, CALFED has:

- Funded the San Joaquin River Riparian Habitat Restoration Program Pilot Project to establish and maintain riparian habitat, using releases from Friant Dam to disperse and germinate native tree seed in the spring.
- Launched the Salinity and Selenium Project and began design of a pilot plant to treat agricultural drainage and produce water for reuse.
- Explored a water quality exchange partnership between the Friant Water Users Association and the Metropolitan Water District.
- Began evaluating the San Joaquin River's discharge of selenium on the Delta.

12.4.1.1. CALFED Ecosystem Restoration Program

The CALFED Ecosystem Restoration program and the San Joaquin River Restoration Program have much in common. CALFED is directing enormous financial resources to restore ecosystem form and function, as a way to improve overall ecosystem health and benefit priority species. While this approach is relatively new, most scientists generally agree this approach provides the best opportunity to restore ecosystem health and priority species within highly regulated conditions, and will likely be the preferred approach on the San Joaquin River. Experimentation with large scale channel reconstruction and gravel augmentation in the San Joaquin River tributaries will test the effectiveness of these approaches, and yield information which can then be evaluated for similar restoration opportunities in the San Joaquin River. CALFED has also invested heavily in screening riparian water diversions to reduce fish mortality caused by entrainment at unscreened pumps. Below the Merced River, the lower San Joaquin River is a critical stretch of river, not only for the upper San Joaquin restoration efforts, but also for the Merced, Tuolumne, and Stanislaus rivers. Improvements in this lower reach, funded by CALFED, will directly benefit San Joaquin River restoration efforts upstream of the Merced River.

12.4.1.2. Integrated Storage Investigation

In the ROD, CALFED identified among other things, investigating the potential for new groundwater and surface water storage as a possible way to increase water supply reliability, and to provide water for the environment. The ROD mandates: (1) the investigation of the feasibility of creating 500,000 to 1 million acre-feet of additional supplies through groundwater banking, (2) for conjunctive use projects, and (3) State and federal investigation of an additional 950,000 acre-feet of off-stream surface storage in the northern Central Valley. Twelve potential surface water projects and many groundwater banking sites were identified by CALFED for further evaluation during Stage 1. One project that is called out for evaluation is an enlargement Friant Dam, or the creation of its functional equivalent, in order to increase storage by 250,000 to 700,000 acre-feet. The Upper San Joaquin River Basin Storage Investigation project is being conducted jointly by USBR and DWR in two phases. The Phase I Appraisal Study has a proposed purpose statement to "Determine if CALFED agencies should pursue a water storage feasibility study that could meet the CALFED goals for upper San Joaquin River Basin storage and assist in solving other regional problems." Phase II would include a Feasibility Study and EIS/EIR. The program held three workshops in 2002. Additional information can be found at <http://www.mp.usbr.gov/sccao/storage/>.

12.4.1.3. Water Transfer

CALFED's Water Transfer Program proposes a framework of actions, policies and processes that will facilitate water transfers and develop a statewide water transfer market. The program calls for establishing a California Water Transfer Information Clearinghouse to facilitate public understanding of transfers, through research and data collection conducted by CALFED. Other actions call for streamlining the current water transfer approval process; increasing the availability of State and Federal storage and conveyance facilities for use in transfers; reducing transfer costs by creating certain classes of "pre-approved" transfers; and establishing "On-Tap," an on-line water transfers information source for California water market transactions.

12.4.1.4. South Delta Improvement Project

The South Delta Improvement Project resulted from the CALFED ROD, and is being implemented by DWR and USBR, with assistance from the US Army Corps of Engineers (ACOE), the California Department of Fish and Game (CDFG), the US Fish and Wildlife Service (USFWS), and the National Marine Fisheries Service (NMFS). The program goal is to incrementally maximize the diversion capability into the Clifton Court Forebay, while maintaining an adequate water supply for the South Delta Water Agency. Diversion into Clifton Court Forebay would allow the State Water Project (SWP) to maximize pumping capability at the Banks Pumping Plant, when risks to aquatic resources are low, thus reducing exports during more sensitive times. This South Delta Improvement Project's activities include:

- Constructing a new screened intake at Clifton Court Forebay.
- Constructing an operable barrier at the head of Old River to reduce entrainment of migrating salmonids into the pumping plants.
- Implementing other actions that ensure water availability while simultaneously contributing to restoring the ecological health of aquatic resources in the lower San Joaquin River and Delta (these actions include dredging, screening agricultural intakes, constructing operable barriers, and improving levees.
- Changing the SWP operating rules to allow export pumping up to the current physical capacity of the SWP export facilities.

The South Delta Improvement Project Alternatives Study Draft Project was released in June 2000, and activities are now in the planning phase. Temporary barriers have been constructed at the Head of Old River during the past several years.

12.4.2. The Central Valley Project Improvement Act (CVPIA)

In 1992, Congress passed the Central Valley Project Improvement Act (CVPIA) to reform management and operations of the Central Valley Project (CVP), particularly to protect, restore, and enhance fish and wildlife. CVPIA amended previous authorizations of the CVP to include: (1) a statement that fish and wildlife protection, restoration, and mitigation are project purposes having equal priority with irrigation and domestic water uses, and (2) language stating that fish and wildlife enhancement has a priority equal to that of power generation. Additional background information can be found at <<http://www.mp.usbr.gov/cvpia/index.html>>. Section 3406 c(1) specifically addresses the San Joaquin River from Friant Dam to the Merced River:

3406 (c) SAN JOAQUIN AND STANISLAUS RIVERS. - The Secretary shall, by not later than September 30, 1996:

(1) develop a comprehensive plan, which is reasonable, prudent, and feasible, to address fish, wildlife, and habitat concerns on the San Joaquin River, including but not limited to the streamflow, channel, riparian habitat, and water quality improvements that would be needed to reestablish where necessary and to sustain naturally reproducing anadromous fisheries from Friant Dam to its confluence with the San Francisco Bay/Sacramento-San Joaquin Delta Estuary. Such plan shall be developed in cooperation with the California Department of Fish and Game and in coordination with the San Joaquin River Management Program under development by the State of California; shall comply with and contain any documents required by the National Environmental Policy Act and contain findings setting forth the basis for the Secretary's decision to adopt and implement the plan as well as recommendations concerning the need for subsequent Congressional action, if any; and shall incorporate, among other relevant factors, the potential contributions of tributary streams as well as the alternatives to be investigated under paragraph (2) of this subsection. During the time that the Secretary is developing the plan provided for in this subsection, and until such time as Congress has authorized the Secretary to implement such plan, with or without modifications, the Secretary shall not, as a measure to implement this title, make releases for the restoration of flows between Gravelly Ford and the Mendota Pool and shall not thereafter make such releases as a measure to implement this title without a specific Act of Congress authorizing such releases. In lieu of such requirement, and until such time as flows of sufficient quantity, quality and timing are provided at and below Gravelly Ford to meet the anadromous fishery needs identified pursuant to such plan, if any, entities who receive water from the Friant Division of the Central Valley Project shall be assessed, in addition to all other applicable charges, a \$4.00 per acre-foot surcharge for all Project water delivered on or before September 30, 1997; a \$5.00 per acre-foot surcharge for all Project water delivered after September 30, 1997 but on or before September 30, 1999; and a \$7.00 per acre-foot surcharge for all Project water delivered thereafter, to be covered into the Restoration Fund.

The CVPIA includes several programs that will benefit future restoration activities in the upper San Joaquin River. Within the CVPIA 'core programs', water conservation standards (Section 3405(e)) have increased the firm water supply available to the CVP. Within 'other programs', upgrades to the Tracy and Contra Costa Pumping Plant fish protection facilities have reduced the juvenile salmonid mortality associated with entrainment at the pumping facilities (Section 3406(b)(4-5)). Implementation of the Non-Flow Stream Restoration Actions (Section 3406(b)(13)) has resulted in installation of fish protection devices at Banta-Carbona, planning and design components for West Stanislaus, Patterson, and El Solyo Irrigation District diversions, as well as screens at numerous small riparian diversions. The CVPIA also has helped to fund the San Joaquin River Riparian Habitat Restoration Program that is a partnership of Friant Water Users Authority, NRDC, the Pacific Coast Federation of Fishermen's Associations, the San Joaquin River Exchange Contractors, USFWS and the USBR.

12.4.2.1. Anadromous Fish Restoration Program (AFRP)

The Anadromous Fish Restoration Program (AFRP) is one of the central programs originating from the CVPIA legislature, with the directive to "develop and implement a program that makes all reasonable efforts to at least double natural production of anadromous fish in California's Central Valley streams." The U.S. Fish and Wildlife Service (USFWS) has assumed lead responsibility for the Anadromous Fish Restoration Program (AFRP). The AFRP program developed a three-

volume *Working Paper on Restoration Needs*, completed in 1995. Volume I describes the process for completing the Restoration Study, and summarizes the production goals, limiting factors, and restoration actions developed by AFRP technical teams. Volume II provides detailed background information for Central Valley rivers, historic and existing conditions, and identifies roles and responsibilities of State and Federal resource agencies. Volume III includes the complete production goals, limiting factors, and restoration actions sections as submitted by the AFRP technical teams.

The AFRP Program released a Revised Draft Restoration Plan (USFWS AFRP 1997) to be used to guide the long-term development and implementation of the AFRP program. The AFRP Restoration Plan provides a programmatic-level description of the AFRP, and is used to guide implementation of all sections of the CVPIA that contribute to AFRP goals. The Revised Draft Plan was adopted as Final in 2001.

The AFRP is the implementation arm of the CVPIA's Central Valley Project Restoration Fund, and has funded numerous, large restoration projects throughout the Central Valley since 1995. Prior to FY2001 funding cycle, AFRP developed an annual workplan that delineated projects to be funded by the CVPIA Restoration Fund. In 2000, for example, AFRP funded approximately \$5.4 million in projects in the Central Valley. In 2001 and 2002, AFRP was integrated into the CALFED Ecosystem Restoration Program proposal solicitation process, with the opportunity to select projects that specifically meet AFRP priorities. AFRP priorities were also considered during development of the CALFED Ecosystem Restoration Plan (ERP) Stage 1 Implementation Plan. The CVPIA legislation explicitly precludes expenditure of CVPIA Restoration Funds for projects upstream of the Mendota Pool.

12.4.2.2. CVPIA Comprehensive Plan

In Section 3406(c)(1) of the CVPIA, the USBR and USFWS were directed to:

“develop a comprehensive plan which is reasonable, prudent, and feasible, to address fish, wildlife, and habitat concerns on the San Joaquin River, including but not limited to the streamflow, channel, riparian habitat, and water quality improvements that would be needed to reestablish where necessary and to sustain naturally reproducing anadromous fisheries from Friant Dam to its confluence with the San Francisco Bay Sacramento-San Joaquin Delta Estuary.”

The USBR and USFWS began work on the Comprehensive Plan, and an initial draft report was prepared by 1995. However, the Working Group (consisting of the Friant Water Users Authority, the Natural Resources Defense Council, and the Pacific Coast Federation of Fisherman's Associations) could not reach consensus on several components of the Plan, and the Plan was not completed. The Working Group recognized that the Secretary of the Interior was directed by Federal statute to complete the Comprehensive Plan, subject to Congressional appropriation of funds for that purpose. The Working Group also recognized that use of a Friant Surcharge to complete San Joaquin River Basin restoration projects would require a study or other biological analyses in order to fund proposed projects. To that end, a partnership between the Friant Water Users Authority (FWUA) and the Natural Resources Defense Council (NRDC) created the San Joaquin River Riparian Habitat Restoration Project. The partnership is now developing a more comprehensive plan for restoring native fish and wildlife on the San Joaquin River below Friant Dam. The Comprehensive Plan, as a result of public and political pressures was not funded by Congress and was never completed.

The incomplete draft of the original Comprehensive Plan contained descriptions of historical and existing conditions and a fairly exhaustive list and descriptions of fish and wildlife species within the San Joaquin basin, but it did not contain a substantive implementation component.

12.4.2.3. San Joaquin River Riparian Habitat Restoration Program

The San Joaquin River Riparian Habitat Restoration Program was established in 1997 and is a collaborative effort involving the Friant Water Users Authority, Natural Resources Defense Council and the Pacific Coast Federation of Fishermen's Associations, the US Bureau of Reclamation, the US Fish and Wildlife Service, and the San Joaquin River Exchange Contractors to improve environmental conditions in and along the San Joaquin River. Through this program, several reports have been prepared, describing riparian conditions along the San Joaquin River, including (these reports are found on the web at <http://www.mp.usbr.gov/cvpia/sjr/index.html>):

- Historical Riparian Habitat Conditions of the San Joaquin River: Friant Dam to the Merced River (JSA 1998a).
- Analysis of Physical Processes and Riparian Habitat Potential of the San Joaquin River: Friant Dam to the Merced River (JSA 1998b).
- A Draft Evaluation of Opportunities for Riparian Restoration and Open Space Uses at Firebaugh, CA (JSA 1999).

Current projects sponsored by the Riparian Program include:

- Development of a restoration plan for the Milburn Ecological Reserve and Hanson Property in partnership with the San Joaquin River Parkway Trust, CDFG and the DWR;
- Long-term bird monitoring in partnership with the PRBO;
- Development of an invasive exotic weed management plan in conjunction with the San Joaquin River Parkway Trust.

Completed projects on the river include activities such as a river clean-up at San Marcos Avenue.

12.4.2.4. Experimental Pilot Projects

Experimental pilot projects have been implemented on the upper San Joaquin River in the Study Area under a Work Plan of the Friant-NRDC partnership since 1999. These pilot projects are intended to fill data gaps regarding critical processes and functions of the San Joaquin River necessary for the development of a restoration plan. Each of these studies has examined particular aspects of restoring the river, and have generated valuable data on: (1) germination and establishment of woody riparian vegetation, (2) modeling and evaluating roughness relative to vegetation establishment, (3) water temperatures, (4) losses from seepage and priming rates, and (5) hydrologic effects of varied flow regimes. These projects have been funded by a combination of sources, including the CVPIA for NEPA documentation and some of the modeling, CALFED, Proposition 13, the water districts and partners.

12.4.3. Water Acquisition Programs

In the last decade, several programs have been established to either purchase or reallocate water for the environmental benefit of the Central Valley. These water acquisition programs include: (1) CALFED Environmental Water Account; (2) CALFED Environmental Water Program; (3) CVPIA Section 3406(b)(2) and (b)(3), and (4) the CVPIA Water Acquisition Program.

12.4.3.1. CALFED Environmental Water Account (EWA)

Provisions for creating and implementing the CALFED Environmental Water Account (EWA) are contained in the CALFED EIS/EIR and ROD. It is cooperatively managed by the U.S. Bureau of Reclamation (USBR), California Department of Water Resources (DWR), USFWS, NMFS, and CDFG. The EWA is a component of CALFED's Water Management Strategy; its intent is to protect endangered and threatened fish species of the Bay-Delta by changing SWP and CVP operations, while maintaining deliveries for agricultural and urban uses. Through the EWA, the CALFED agencies control a package of "assets" that includes money, water, and storage and conveyance rights. The assets package allows more flexible operations to benefit environmental resources. For example, the EWA assets can be used to augment instream flows and Delta outflows, modify exports to benefit fisheries, and replace any water reduced by changes in project operations.

12.4.3.2. CALFED Environmental Water Program (EWP)

The CALFED Environmental Water Program (EWP) is intended to acquire water for flow -related goals contained in the CALFED Ecosystem Restoration Program (ERP). Through the EWP, the CALFED agencies will:

- Acquire water from sources throughout the Bay-Delta watershed, to provide flows and improve habitat conditions for fishery protection and recovery.
- Restore critical instream and channel-forming flows in Bay-Delta tributaries.
- Improve Delta outflows during critical periods.
- Improve salmon spawning and juvenile survival in upstream tributaries, as defined by the ERP and ERP Strategic Plan. Improvement will be accomplished by purchasing up to 100,000 acre-feet of water per year by the end of Stage 1; some of these flows may contribute to the CALFED EWA.

The EWP is relatively new, and was not specifically addressed in the CALFED EIS/EIR and ROD. Therefore, sources or uses of water are not limited or specifically restricted. The EWP program defines how water will be acquired, managed, and developed, as CALFED agencies and stakeholders build the program's framework. Because the EWP program is associated with the CALFED ERP, the CALFED Science Program will likely be included with the EWP's implementation and adaptive management.

12.4.3.3. CVPIA Water Acquisition Programs

The CVPIA included three sections specifically addressing water acquisition and reallocation: Sections 3406(b)(1), (b)(2), and (b)(3). Section 3406 (b)(1) requires re-operating the CVP and creating the Anadromous Fish Restoration Program (AFRP), which were discussed previously. Section (b)(2) dedicated 800,000 acre feet of Central Valley Project yield "for the primary purpose of implementing the fish, wildlife, and habitat restoration purposes". This water was not intended to be obtained from the Friant Division of the CVP, and has no direct implications on the San Joaquin River Restoration Study.

Section 3406 (b)(3) requires that a program be developed and implemented to acquire water supplies that will assist in achieving restoration goals of the AFRP program. This mandate led to the CVPIA Water Acquisition Program (WAP). The WAP's intent is to meet two specific CVPIA goals: (1) to beneficially augment instream flows in Central Valley rivers and streams; and (2) to provide water for State and Federal wildlife refuges and the Grasslands. Since the program was enacted in 1992, the WAP has acquired water annually to meet the water needs of anadromous fish and wildlife refuges.

The WAP is coordinated by USBR, with cooperation from NMFS and USFWS. The USFWS is defining the biological needs and hydrologic characteristics of several regulated and unregulated Central Valley rivers and streams, as well as water needs at wildlife refuges.

12.4.4. San Joaquin River Management Program

The San Joaquin River Management Program (SJRMP) originally was authorized by Assembly Bill 3603 and signed by the Governor on September 18, 1990. The SJRMP includes the entire river from Friant Dam to the Bay-Delta, and provides a forum for identifying and supporting projects and programs that address water quality, water supply, flood protection, fisheries, recreation, and wildlife in the San Joaquin River system. The San Joaquin River Management Plan, completed in 1995, identified nearly 80 consensus-based restoration actions and studies that would benefit the San Joaquin River system and its many users. The SJRMP provides a regional forum in the San Joaquin River basin for local, state, and federal agencies and interested stake holders including agricultural, business, recreational interests as well as environmental groups and landowners.

The program funded several projects on the Stanislaus River, reviewed and recommended projects for other grants, consistent with SJRMP goals. To increase the value of its restoration efforts, the program has recently become coordinated with CALFED, plans to hire a full-time program director, and will obtain funding to implement some of its projects.

12.4.5. VERNALIS ADAPTIVE MANAGEMENT PROGRAM

As part of on-going efforts to restore and protect fish resources, and yet maintain water supply reliability, State and Federal resource agencies, the San Joaquin River Group, CVP/SWP interests, and environmental interests developed a Draft San Joaquin River Agreement (SJRA) to meet the San Joaquin River flow objectives contained in the SWRCB 1995 Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (SWRCB 1995). The SJRA includes the Vernalis Adaptive Management Plan (VAMP).

The VAMP program is an experimental program designed to determine juvenile salmonid survival under various river flows and SWP/CVP export operations. In 1999, VAMP began implementing annual 31-day pulse flows during the spring outmigration period. Pulse flows are coordinated with releases of large groups of tagged, hatchery-reared, juvenile salmon, which were wire-tagged and provided by the Merced River Hatchery. The VAMP experiments measure salmon survival rates under six combinations of flow and export rates. Under each of the experimental conditions, Chinook salmon survival rates were then calculated. The primary recapture locations were: (1) Chipps Island (a location where FWS conducted previous studies), and (2) at an intensively sampled location in the lower San Joaquin River near Antioch, (3) at the SWP and CVP fish salvage facilities, and (4) in the ocean fishery. VAMP is scheduled to conduct pulse-flow studies through 2010. In addition to assessing the relationship between CVP/SWP export rates and salmon survival, the controlled spring pulse-flows will also allow the evaluation of temperature and water quality issues, in the San Joaquin River and Bay-Delta, related to flow magnitude and timing.

12.4.6. US Army Corps of Engineers Comprehensive Study

The US Army Corps of Engineers (ACOE) and the Reclamation Board of California initiated the Sacramento and San Joaquin River Basins Comprehensive Study, to develop a system-wide, comprehensive flood management plan for the Central Valley, which would reduce flood damage and provide ecosystem restoration. Three broad planning objectives were identified for the Comprehensive Study: (1) improve flood risk management throughout the system; (2) to ensure

that future project meet the dual objectives of increased flood damage reduction and ecosystem restoration; and (3) resolve policy issues and address limiting institutional procedures.

The Comprehensive Study conducted a system-wide evaluation of the Sacramento and San Joaquin River Basins, and developed ways to analyze system changes. A suite of hydrologic and hydraulic models allow an understanding of how floods of various frequencies move through nearly 70 reservoirs, 500 miles of river channels, and over 2 million acres of floodplain. These models were used to assess potential system-wide effects when the existing flood management system was modified. The models' results were then used as a basis for future project development.

The ACOE has released the "Sacramento and San Joaquin River Basins Comprehensive Study, California: Interim Report, December 6, 2002". This report is available on the web at www.compstudy.org. Basin-wide evaluations led to several important findings about the flood management system, including:

- The system cannot safely convey the flows that it was formerly considered capable of accommodating.
- If levee reliability were improved system-wide, substantial increases in flood storage capacity would be necessary to avoid transferring increased flood risks to downstream areas.
- A comprehensive solution to improve public safety, reduce flood damages, and restore degraded ecosystems will require a combination of measures that increase conveyance capacity, increase flood storage, and improve floodplain management.

The Comprehensive Study stopped short of providing an integrated plan for implementing projects to improve flood risk management and ecosystem restoration. However, the Comprehensive Study developed a process to develop future projects that meet the equal goals of: (1) improved flood management, and (2) ecosystem restoration. The Comprehensive Study process consists of a set of "guiding principles" that include:

- Recognize that public safety is the primary purpose of the flood management system.
- Promote effective floodplain management.
- Recognize the value of agriculture.
- Avoid hydraulic and hydrologic impacts.
- Plan system conveyance capacity that is compatible with all intended uses.
- Provide for sediment continuity.
- Use an ecosystem approach to restore and sustain the health, productivity, and diversity of the floodplain corridors.
- Optimize use of existing facilities.
- Integrate with the CALFED Bay-Delta Program and other programs.
- Promote multi-purpose projects to improve flood management and ecosystem restoration.
- Protect infrastructure.

The Interim Report sets the foundation for future modifications to the flood management system, first by identifying the need to manage the rivers of the Sacramento and San Joaquin River Basins in a comprehensive and system-wide manner, then by providing guiding principles to help achieve this goal.

12.4.7. San Joaquin Valley Drainage Program

The San Joaquin Valley Drainage Program was formed in 1984 as an interagency organization composed of the USBR, US Geological Survey (USGS), USFWS, CDFG, and DWR. Its purpose was to investigate drainage and drainage-related problems, and to develop possible solutions in the San Joaquin Valley. In 1990, the Program finalized *A Management Plan for Agricultural Subsurface Drainage and Related Problems on the Westside San Joaquin Valley* (Management Plan) that sought to address environmental concerns and drainage management, but did not address the Valley's long-term salt balance issues. The Management Plan can be found on the web at: <http://www.dla.water.ca.gov/agriculture/drainage/implementation/hq/sjvlib.htm>

The major components of the Management Plan are:

- Source control—On-farm improvements in applying irrigation water to reduce the source of deep percolation.
- Drainage usage—Plans for drainage-water reuse on progressively salt-tolerant plants.
- Evaporation system—Plans for evaporation ponds that store and evaporate drainage water that remains after reuse on salt-tolerant plants.
- Land retirement—Retirement of areas where underlying groundwater contains elevated levels of selenium and where soils are difficult to drain.
- Groundwater management—Pumping of the semi-confined aquifer, where near-surface water tables can be lowered and where water pumped out is of suitable quality for irrigation or wildlife habitat.
- Discharge to the San Joaquin River—Controlled and limited discharge of drainage water from the San Luis portion of the study area to the San Joaquin River.
- Protection, restoration, and provision of substitute water supplies for fish and wildlife habitat—Provides fresh water to substitute for drainage contaminated water that was previously used on wetlands.
- Institutional change—Changes include tiered water pricing, improved water delivery schedules, water transfers and marketing, and forming regional drainage management organizations.

The Management Plan was then used as the primary guide for the San Joaquin Valley Drainage Implementation Program, developed through a memorandum of understanding (MOU) among Federal and State agencies. This Program provides a framework that will allow the present rate of agricultural development in the valley to continue, while protecting fish and wildlife and helping to restore their habitat to the levels that existed before direct impact by the contaminated drainage water. The MOU is available on the web at: <http://www.dla.water.ca.gov/agriculture/drainage/implementation/hq/mem.htm>

12.4.8. San Luis National Wildlife Refuge Complex

The USFWS's San Luis National Wildlife Refuge Complex (NWRC) includes the San Luis National Wildlife Refuge (NWR) (Kesterson, East Bear Creek, West Bear Creek, and Blue Goose), the Merced NWR, and the San Joaquin NWR. These refuges form a mosaic of wetlands, grasslands, and riparian habitats, and agricultural fields, formed from former agricultural lands, by flooding and breaching levees. Most of the refuge lands are periodically maintained by controlled burns and periodic tilling to

maintain vegetation succession. In addition, forage crops are planted for the waterfowl. Collectively, the 47,700 acres of wildlife refuge provide habitat to the recently de-listed Aleutian Canada Goose (San Joaquin River NWR), many other waterfowl and neotropical migratory birds.

The NWRC is preparing long-term (15-year) program planning documents. Beginning with the San Joaquin NWR, the documents will guide present and future development of the NWRC. One critical issue is the potential expansion of the NWRC to include additional parcels, especially land surrounding the confluences of the Merced, Tuolumne, and Stanislaus Rivers with the San Joaquin River. This potential expansion could play a key role in the San Joaquin River restoration program, in lower San Joaquin flood management, and in water quality issues of the entire river.

12.4.9. Lower Tributaries Restoration Programs

The three mainstem tributaries of the lower San Joaquin River include the Merced, Tuolumne and Stanislaus Rivers. The Stanislaus River is regulated by the New Melones Reservoir, owned and operated by the USBR. Dams on the Merced and Tuolumne Rivers are both privately owned, and have well-developed stakeholder organizations and restoration programs. Coordinating the San Joaquin River restoration efforts with those of these three tributaries will be critical to the success of the San Joaquin River efforts, particularly in maximizing restoration opportunities along the lower San Joaquin River.

The Turlock and Modesto Irrigation Districts (the Districts), in cooperation with CDFG and the FWS, conducted extensive studies of Chinook salmon population dynamics and habitat in the lower Tuolumne River, as part of the Don Pedro Project FERC Study Program. The objective of these studies was to identify potential management actions that would increase Chinook population abundance and improve Chinook salmon habitat in the Tuolumne River. In 1995, through the Don Pedro FERC relicensing process, the Districts and the City and County of San Francisco entered into a FERC Settlement Agreement with the FWS, CDFG, and several environmental groups. The FERC Settlement Agreement established minimum flow requirements for the Tuolumne River downstream of the Don Pedro Project, and it set forth a strategy to recover the lower Tuolumne River Chinook salmon population. The Tuolumne River Technical Advisory Committee (TRTAC) developed the *Habitat Restoration Plan for the Lower Tuolumne River Corridor* (McBain and Trush 2000), that integrates fluvial geomorphic processes with ecosystem recovery and Chinook salmon restoration. Because this strategy will be carried out under contemporary regulated flow and sediment regimes, this goal targets a “scaled-down” version of a dynamic alluvial river (sediment transport and scour, floodplain inundation, channel migration) that creates and maintains habitats favored by Chinook salmon and other fish, bird, and wildlife populations. Several large-scale channel reconstruction projects are identified in the Habitat Restoration Plan, and these projects are currently being implemented by the Districts, CCSF, CDFG, FWS, Friends of the Tuolumne, and Tuolumne River Preservation Trust.

The Merced River restoration program, initiated in 1997, includes a broad spectrum of participants, including the Merced County Planning and Community Development Department, CDFG, DWR, , and the Merced River Stakeholder Group and Technical Advisory Committee. The *Merced River Corridor Restoration Plan* (Stillwater Sciences 2002) was completed in February 2002, and the plan provides a technical basis for restoration, unifies public support, and guides implementation of the restoration program. The goal of the Merced Restoration Plan is to improve, to the extent feasible, ecological conditions that benefit native fish and wildlife, while recognizing, protecting, and addressing the concerns and rights of property owners and other stakeholders (Stillwater Sciences 2002). Several large channel reconstruction and habitat enhancement projects are being implemented by DWR on the Merced River, to improve ecological conditions, riparian habitat, and habitat for fall-run Chinook salmon.

The Stanislaus River’s stakeholder group and restoration program are still developing and may be less advanced than programs on the Tuolumne or Merced Rivers, but the Stanislaus has nevertheless implemented several studies and restoration projects to improve conditions for fall-run Chinook salmon and steelhead populations. Spawning gravel replenishment projects have been implemented in Goodwin Canyon and at Knights Ferry. Radio-tracking experiments with emigrating juvenile salmon have also been conducted on the Stanislaus River to evaluate salmonid predation (Demko et al. 1999).

The three tributaries of the lower San Joaquin River are critically important to the restoration program in the San Joaquin River. The above mentioned CALFED projects will yield useful information for implementing restoration on the San Joaquin River; plus, the tributaries’ fall-run Chinook and steelhead will likely provide the best genetic stock for reintroduction into the San Joaquin River. Recent tributary restoration efforts and/or improved hydrologic and ocean conditions have helped improve and sustain escapement numbers in the past several years, rebounding from critically low levels in the early 1990s.

The AFRP population targets for the three tributaries total 78,000 fall-run Chinook salmon (Table 12-1). Targets for spring Chinook and steelhead are not provided for individual tributaries, but for the entire Sacramento and San Joaquin River drainage, the targets are 68,000 spring-run Chinook and 13,000 steelhead. Achieving the AFRP and other program escapement targets will directly affect the success of the San Joaquin River restoration program, by providing a strong, local population base for transplant and/or straying. Steelhead appear to be more abundant in the Stanislaus River than in the other tributaries, and the Stanislaus River may be an important source for recolonizing and establishing a viable steelhead population on the San Joaquin River.

Table 12-1. Escapement, harvest, and production targets for fall-run Chinook salmon in each of the tributaries to the San Joaquin River established by the AFRP program. No production targets were established for spring-run Chinook salmon or steelhead in San Joaquin basin tributaries.

	Total Production Goal	Escapement	Harvest	Production
Stanislaus River	22,000	4,800	6,040	11,000
Tuolumne River	38,000	8,900	9,950	19,000
Merced River	18,000	4,500	5,330	9,900
San Joaquin River	not specified	not specified	not specified	not specified
TOTAL	78,000 (not including San Joaquin River)	18,200	16,520	39,900

12.4.10. Floodplain Management Task Force

AB 1147 signed by Governor Davis last year, authorizes twelve flood control projects, modifies the State local cost-sharing formula for participation in federal flood protection projects, significantly increases the State’s oversight on federal flood control projects and recommends establishment of a Floodplain Management Task Force. This Task Force must complete its work by December 31, 2002.

The focus of the Task Force is to examine specific issues related to State and local floodplain management, including actions that could substantially reduce potential flood damages and to make recommendations for more effective statewide floodplain management policies.

12.4.11. CALFED ERP 2002 Projects that are Recommended for Funding

River restoration activities within the San Joaquin basin have accelerated in the last decade, primarily because of the availability of funding from CALFED and CVPIA/AFRP. There are too many projects to present in this chapter that may have information relevant to the San Joaquin River restoration effort. Instead we provide an example of projects that recently received funding from CALFED. This is intended to provide managers with a better understanding of the types of restoration activities that offer opportunities for coordination with the San Joaquin River restoration effort.

12.4.11.1. Tri-Dam Project: Stanislaus -Lower San Joaquin River Water Temperature Modeling and Analysis

This proposal is to improve temperature models for the Stanislaus River and lower San Joaquin River to improve water temperatures from reservoir releases to benefit salmon, steelhead, and other fish, and was recommended for \$661,902 in funding. This proposal extends the existing water temperature model to the entire river system, from New Melones to the Bay-Delta, including that portion of the San Joaquin River between the Stanislaus River confluence and Mossdale Bridge. New information will refine the temperature model and help improve water temperature in the Stanislaus River and Lower San Joaquin River.

12.4.11.2. Water Tech Partners: Full-Scale Demonstration of Agricultural Drainage-Water Recycling Process Using Membrane Technology

This demonstration project was funded for \$316,090 and seeks to test whether sustained, full-scale operation of an on-farm, tile-water recycling process can eliminate off-farm drainage disposal. This recycling process is the most technically, economically, and environmentally viable process for achieving the selenium water quality objectives for the San Joaquin River watershed. If the prototype full-scale demonstration project is successful, more plants will be built, possibly decreasing selenium discharge into the San Joaquin River by 80 percent.

12.5. DOWNSTREAM OPPORTUNITIES AND CONSTRAINTS

The lower San Joaquin River is an integral component of the success of restoration efforts in the upper San Joaquin River. Besides the obvious hydrologic connectivity, the two river sections also share flood control system components, similar urban and agricultural land uses, and water quality issues. Many of the downstream issues are both opportunities and constraints, depending on how the issue is viewed. For example, existing water quality conditions in the lower San Joaquin River may pose a critical constraint to the restoration of anadromous salmonids in the upper San Joaquin River, simply in terms of their survival of those conditions. But adding more water from the San Joaquin River may allow improvements to water quality, with consequent benefits that extend beyond just anadromous salmonids. Several other issues are similarly balanced.

12.5.1. Flood Management

The climate and geology of the Central Valley dictate inevitable periodic flooding of the major river systems. Since Euro-American settlement in California, many large floods have occurred, occasionally with loss of life and property damage. Beginning as early as 1910, frequent flooding resulted in coordinated flood protection planning, flood control structures, and non-structural alternatives, which have converted vast areas of undeveloped and uncontrolled floodplain into

reclaimed agricultural lands, and more recently, into urban population centers throughout the Central Valley. The primary flood control strategy was the construction of large reservoir impoundments, channel straightening and confinement, levee construction, and flood bypass channels.

The primary opportunity in terms of improved flood management is to increase the flood capacity and storage in the 65 mile-long reach from the Merced River confluence to the Delta, by such actions as setting back levees or creating transitory storage areas like the Yolo bypass. This activity has enormous benefits not only to flood management, but also to several ecosystem components and functions, such as: (1) a restored floodplain that can provide high quality habitat for native fish and anadromous salmonids, (2) an increase in riparian habitat available for avian and wildlife species, and (3) potential for channel migration, large wood recruitment, and other important fluvial processes that are important to river ecosystem maintenance. Opportunities for restoring river corridor habitat, while maintaining flood control capacity, occur in the lower San Joaquin River from the mouth of the Stanislaus River downstream to Old and Middle rivers (Figure 12-1). Opportunities also exist along the San Joaquin Channel into the Central Delta. As addressed in the Comprehensive Study (ACOE 2001), opportunities exist for expanding shaded riverine aquatic habitat on the San Joaquin River and on its lower tributaries, from Stockton upstream to the mouth of the Merced River along Federal levees.

Waterside slopes of levees are subject to erosion from wind-generated waves, boat wakes, and water flowing at high velocity. State and local governments have invested millions of dollars in the past 10 years to maintain and repair eroded levees. The Delta Levees Maintenance Subvention Program (Senate Bill 1065) was developed to assist in levee maintenance, but requires that no net loss of fish and wildlife habitat should be associated with levee maintenance along the San Joaquin River below Stockton. SB 1065 also provided \$3 million to mitigate past habitat loss in this area.

Improvements to Delta levees and channels are included in the CALFED ROD to reduce the risk of floods from earthquake and general deterioration of the levees. These improvements to system integrity will be accomplished through developing and implementing the Delta Long-term Levee Protection Plan. The plan will include a maintenance/stabilization element and a Special Projects element; the two elements will address levee maintenance, stabilization improvements, subsidence, emergency levee management, beneficial reuse of dredged material, and establishment of habitat corridors, as mitigation for impacts caused by maintenance and stabilization. The Delta Long-term Levee Protection Plan will provide a uniform approach for improving system reliability. Uniform funding and guidance for levee maintenance and/or improvements to a construction standard would be available to Delta islands on a cost-shared basis. Funding for flood control and habitat improvements would be distributed through a priority system, to ensure long-term protection of Delta system functions, which provide the highest public benefit.

12.5.2. Project Levees

Federal flood control levees channelize the lower San Joaquin River, from the mouth of the Merced River to Stockton, and along its lower tributaries. In their present condition, these levees confine the river, reduce inundated area, and degrade main channel habitat (McBain and Trush 2000). Considerable opportunity exists to simultaneously address flood control problems and re-create high quality floodplain and aquatic habitat in the lower river by pulling levees back and expanding the floodway corridor width. Expansion of the floodplain can reduce flood risks while improving river and floodplain habitats for San Joaquin River native fish populations, as well as for many avian and wildlife populations. Setback levees can add substantial rearing habitat for juvenile salmon and steelhead emigrating from the upper San Joaquin River and tributary rivers during periods of high flows. This habitat includes floodplains, side channels, sloughs, riparian forests, and wetlands that

are seasonally inundated at high river stages. Tidal and seasonal wetland habitat in the floodplain of the lower San Joaquin River would substantially add to the rearing habitat available for juvenile salmonids of upper San Joaquin River origin, as well as salmonids originating from the Merced, Tuolumne, and Stanislaus rivers. Lower river and estuary rearing habitat is presently impaired by reclamation projects. The present condition of late winter and springtime salmonid rearing habitat in the mainstem river can limit growth of juvenile salmonids, particularly under high turbidity and low temperatures typical of snowmelt and winter runoff conditions. Expansion of the floodplain into a dual-purpose floodway/wildlife habitat corridor would improve these conditions.

12.5.3. Entrance to Old River

In the Bay-Delta and lower San Joaquin River, many barriers and bypass channels hinder migrating adult and juvenile salmonids, thus affecting their survival. These migratory barriers are discussed in more detail in Chapter 7. However, several barriers are planned in the South Delta as part of the DWR/CALFED South Delta Program that benefit emigrating juvenile salmonids, including the barrier at the mouth of Old River. This barrier is installed temporarily during juvenile and smolt outmigration period, and is designed to keep fish in the San Joaquin River and away from the CVP and SWP diversions at Clifton Court Forebay. The barrier would thus reduce juvenile salmonid mortality associated with entrainment at Delta pumping facilities and reduce migration travel time through the Delta.

12.5.4. CDFG Fish Screen and Fish Passage Program

The California Department of Fish and Game manages the Fish Screen and Fish Passage Program, which has the following goals (Raquel et al. 2002):

- Inventory water diversion and fish passage problems.
- Evaluate and prioritize fish screening and fish passage problems.
- Implement and/or coordinate fish protection activities.
- Evaluate existing and proposed fish protective installations.
- Review fish screening and fish passage literature.

Downstream of Vernalis, the program has identified over 2,200 diversions. Of these, only 1% have fish barrier structures that meet delta smelt or salmon design criteria. The majority (approximately 45%) of diversions/barriers in the Delta are siphons. Of the unscreened diversions:

- 5 diversions have intakes larger than 250 inches in diameter.
- 18 diversions have intakes between 51-65 inches in diameter.
- 131 diversions have intakes between 21-50 inches in diameter.
- 2,064 diversions have intakes smaller than 20 inches in diameter.

In the lower San Joaquin River from the Merced River to Vernalis, the program identified 62 diversions, with only a single screened diversion (the Banta-Carbona Irrigation District) that meets delta smelt, steelhead, and salmon design criteria. Unscreened diversions include (Raquel et al. 2002):

- 2 diversions with intakes larger than 65 inches in diameter (both >249 cfs capacity).
- 1 diversion with intake between 21-50 inches.
- 59 diversions with intakes larger than 20 inches in diameter.

These diversions are a significant constraint to native fish restoration efforts in the upper San Joaquin River. Clearly, the lower San Joaquin River and Delta has considerable potential to impact native fish populations, including anadromous salmonids, and will continue to contribute to fish mortality and impaired fish populations until most or all these diversions are screened or removed. However, from the perspective that these diversions have been operating for so long, screening or removing the diversions represents a significant opportunity to reduce fish mortality caused by diversions.

12.5.5. Streamflows in lower San Joaquin River

The CALFED and CVPIA programs evaluate the potential for increasing flows on the lower San Joaquin River and its tributaries by re-operating and purchasing water from willing sellers. Flow increases at key times of the year can potentially improve survival of up- and downstream migrating salmon and steelhead. The Vernalis Adaptive Management Program is studying the potential benefits of increased spring flows from tributaries. Federal Energy Regulatory Commission (FERC) hydropower license programs also mandate further study of benefits from increased river discharge at key times of the year. Increased flows will not only improve upstream and downstream passage, but will also provide improved and/or increased floodplain habitat, which would benefit salmonids and limit survival and production of warm-water, non-native, predatory species.

12.5.6. Connectivity of Riparian Habitats with lower SJR Tributaries (Stanislaus, Tuolumne, Merced Rivers)

The lower portions of these tributaries are generally channelized by Federal flood control levees. These channelized reaches interrupt the continuity between the tributaries' extensive riparian habitats and the riparian habitats of the San Joaquin River floodplain. Improving the tributaries' riparian habitats will increase connectivity, which is important to migrating and growing juvenile salmonids. The floodplain riparian forests are important because they provide shade and cover, nutrients, organic material, large woody debris, and insects important in the diet of young salmonids. Riparian habitats also cool the air and shade the water, which can lower water temperatures and potentially extends the period when young salmonids can rear in the lower river in spring. Finally, reconnecting and expanding these riparian habitats may be vitally important to certain native and special-status species (e.g., yellow-billed cuckoo) that require relatively large patches of habitat for their populations to rebound and thrive. Many of the necessary habitat improvements can be accomplished under existing Federal and State programs, including the CALFED program and others identified in previous sections.

12.5.7. Water Quality in the lower San Joaquin River and Delta

Water quality in the lower San Joaquin River and Delta is a significant constraint to restoring fish and aquatic resources in the San Joaquin River (see Chapter 6). Several water quality parameters, including water temperature, salinity, and dissolved oxygen, are of particular concern due to their direct and potentially lethal effects on juvenile salmon and steelhead migrating through the Delta, as well as other native fish species. Additional flow releases would likely substantially assist in attaining water quality objectives in the lower San Joaquin River by diluting the lower river with high quality streamflow. However, if water quality in the lower San Joaquin River and Delta does not substantially improve, impaired water quality conditions will continue to constrain juvenile and adult anadromous salmonid migrations.

12.5.8. Army Corps of Engineers (ACOE) Comprehensive Study

In response to the 1997 flood, the ACOE was directed to conduct a comprehensive assessment of the entire flood control system in the Sacramento and San Joaquin basins. The first step in this comprehensive study was preparation of a comprehensive *Post - Flood Assessment* for the Central Valley (ACOE 1999). This report listed numerous infrastructural and operational problems with the existing flood control system, including:

- The San Joaquin River levee and channel system lacks the capacity to convey design flood flows, and does not extend far enough into the Delta to adequately pass design flows.
- No single entity has responsibility for maintaining the capacity of the river channel from the Merced River downstream to the Delta, resulting in continually decreasing capacity.
- Parts of the levee system do not reliably protect against floods due to structural instabilities, poor foundation conditions, and/or excessive seepage.
- Current operation plans for existing reservoirs, plus the lack of flood storage in reservoirs and in the floodplain, prevent optimal use of the flood management system.

In addition, flood release travel times from Friant Dam are several days longer than travel times of releases from the tributaries. This difference increases the difficulty of management in the lower San Joaquin River.

12.5.9. The Nature Conservancy Restoration Site Studies

This section contains information about restoration opportunities on 12 potential restoration sites (Figure 12-1) on the San Joaquin River, between the Merced River and Old River. These restoration opportunities were developed for a report sponsored by The Nature Conservancy (JSA 1999). The listed opportunities include breaching levees, setting back levees, reconnecting channels, expanding floodplains, and restoring old floodplains to native habitat with a mosaic of native riparian, oak woodland, and grasslands. The report details the locations, habitat descriptions, land uses, and infrastructure for each site. Summaries of the restoration sites follow. References to right bank and left bank are based on a downstream orientation.

12.5.9.1. Paradise Cut (Site 1)

Paradise Cut is an overflow channel of the San Joaquin River, which connects to the Delta. Flow into Paradise Cut is regulated by a weir (the Paradise Cut flood relief structure) and channel capacity is 15,000 cfs. Paradise Cut is bordered on both sides by levees, and it is linear and narrow. Before the levees' construction, this channel likely had greater sinuosity; old meander bends are evident in the soil signatures of adjacent lands. Riparian habitat is limited within Paradise Cut due to agricultural encroachment, channel straightening, and levee construction. Riparian habitat now consists of a narrow band of trees along the bases of the levees. Downstream of the Interstate 5 Bridge, the cut widens. As of July 1998, extensive agricultural fields covered much of the area. Fields within the project levees on both sides of Paradise Cut are protected from flooding by local levees. Some riparian trees grow at the edge of ponded areas within the channel. Several levee breaches occurred along Paradise Cut in the 1997 floods.

Increasing flood conveyance through Paradise Cut has been suggested as a flood-control measure for the San Joaquin River. Several restoration opportunities could improve riparian and wildlife habitat, including:

- Purchasing fee title or conservation easements to adjacent agricultural lands, then breaching the local levees within Paradise Cut, and converting the agricultural lands within these levees to riparian habitats.
- Purchasing fee title or conservation easements, then breaching or setting back levees within the Stewart Tract, and allowing portions of the Stewart Tract to flood during high flows. This would increase temporary flood storage, and would provide habitat for migratory birds and waterfowl. Construction of a levee system to protect the town of Mossdale would be required.
- Restoring riparian and wetland vegetation to appropriate sites within the Stewart Tract, in association with breaching of levees.

12.5.9.2. San Joaquin River RM 57 to 69 (Site 2)

Within this reach, several restoration opportunities could have substantial flood conveyance benefits. Potential projects include:

- Purchasing fee title or conservation easements and setting back levees. Project levees between RM 60 and 61.5, and RM 63 to 65, constrict the floodway. Straightening levees between bends in these two areas would greatly reduce the levee length. Levees currently surrounding two oxbow lakes are only one mile apart, and connecting them would replace approximately 5 miles of existing levee. Straightening levees would return some currently farmed land to the floodplain.
- Removing local levee at RM 68 and purchasing flood-prone agricultural lands on the left bank, between RM 65.5 and 68.5. This action may allow the river to naturally cut off over time, and presents opportunities for natural riparian regeneration. Historically, much of this land was forested.
- Breaching or removing project levees between the Banta-Carbona Canal intake and the site's upstream end at RM 70. The alluvial fan of a tributary draining the Coast Range lies adjacent to the river at this point, and may be close enough to fully contain flood flows.
- Breaching or removing local levees that protect flood-prone agricultural fields within the project levee system.

Some lands within the project levees may be unsuitable for riparian vegetation because the river channel has degraded and the floodplain's elevation above the current river channel is too high to allow natural regeneration. Other plant species may be more appropriate here.

12.5.9.3. Walthall Slough (Site 3)

Walthall Slough, another potential restoration site, is an historical slough system on the right bank of the San Joaquin River, between Weatherbee Lake at RM 57 and RM 67.5. To the west, this site is partially bordered by project levees along the right bank of the San Joaquin River; to the east, it is bordered by local levees and a series of roads to the east. At the upstream end, Walthall Slough is currently separated from the river by project levees and it flows into an old oxbow channel connected to the main river channel at the town of Weatherbee Lake. Portions of the slough connect several existing oxbow lakes, relatively far from the current channel to the west. Much of the historical

riparian forest and marsh vegetation has been replaced by agriculture, although a narrow band of riparian trees line the remaining slough channels.

Reconnecting both ends of Walthall Slough with the San Joaquin River would enhance riparian habitat and increase the flood conveyance capacity of the system. Habitat quality is currently limited because flows are cut off at the slough's upstream. Before levee construction, this slough was likely a natural bypass for floods, and reconnecting it to the main San Joaquin River would restore this bypass function, and convey flow past several constrictions between RM 57 and RM 70. Some options for reconnecting the slough include:

- Reconnecting the slough to an oxbow channel at RM 58.3 rather than at its current point downstream. (The downstream location could negatively affect the town of Weatherbee Lake).
- Re-grading the slough, or constructing a bypass levee system to restrict flows to the slough itself, thereby minimizing impact to surrounding farmlands.
- Constructing a weir or other flow-regulating structure at the upstream end of the slough. The slough would likely have a more consistent water supply, which would improve riparian habitat quality. This option does not have flood control benefits, but additional levee construction may not be needed.

12.5.9.4. Red Bridge Slough (Site 4)

Red Bridge Slough lies along the right bank of the San Joaquin River, between RM 67 and 75, below the confluence with the Stanislaus River. The slough is bordered by San Joaquin River to the west, and the Stanislaus River to the south. The site includes the lowermost two river miles along the right bank of the Stanislaus River.

Red Bridge Slough, like Walthall Slough to the north, appears to be an overflow channel of the San Joaquin River, and may be the site of an historical overflow channel of the Stanislaus River. Both the upstream (RM 67) and downstream (RM 72) ends of Red Bridge Slough are disconnected from the river, lying outside the project levees. In the vicinity of the historical inlet for Red Bridge Slough, another highly degraded slough channel may have been connected to Red Bridge Slough or to the San Joaquin River. Some riparian vegetation grows along Red Bridge Slough, especially in areas with standing water, but much of the riparian and marsh vegetation that probably occurred in this area has been replaced by agriculture.

Restoration opportunities for Red Bridge Slough are similar in concept to those recommended for the Walthall Slough. Reconnecting Red Bridge Slough with the river would enhance riparian habitat and improve flood conveyance. However, Red Bridge Slough may have fewer restoration benefits than Walthall Slough, and may be more difficult to implement.

12.5.9.5. San Joaquin River: RM 70 to 77 (Site 5)

This restoration site is a reach of the San Joaquin River, from the City of San Joaquin to the Hwy 132 Bridge (RM 70 to 77). The upstream end of the site lies on the right bank of the river, and the downstream end lies along the left bank. Along this section of river, native vegetation is better developed than at sites downstream, and the vegetation forms a relatively broad riparian corridor. Numerous oxbows are present. Valley oak is abundant on higher ground, and cottonwood, willow, and box elder grow at lower elevations. The levee system starts south of Sturgeon Bend and continues upstream along the left bank. Two oxbow lakes located at the site's southern end are cut off from the

main river by the levee system and agricultural fields. However, these oxbows are frequently flooded, support emergent wetland vegetation, and are surrounded by native trees and shrubs.

The left bank portion of this site is exceptionally well-suited for nonstructural flood control and riparian habitat restoration. Because of the alluvial fan to the west, breaches in the project levees along the east bank could be allowed to pass into and through the southernmost 500-odd acres of the site. Restoration activities would have little impact on infrastructure. Potential restoration actions include:

- Purchasing fee title or conservation easements and breaching or removing project levees from Hwy 132 to Sturgeon Bend.
- Purchasing fee title or conservation easements and replacing agricultural fields with riparian forest vegetation within the low floodplain and connecting riparian habitat between the river and off-channel oxbow lakes.
- Setting back project levees along the right bank between Airport Road and Sturgeon Bend, and restoring riparian habitat to the reconnected floodplain.

12.5.9.6. Riley Slough (Site 6)

Much of the reach from the Tuolumne River downstream to the Stanislaus River is part of the 11,000-acre San Joaquin River National Wildlife Refuge (NWR), where extensive floodplain restoration projects are in progress. Riley Slough extends along the right bank of the San Joaquin River from the confluence with the Stanislaus River at RM 75 upstream to Hwy 132. A continuous project levee lines the right bank of the San Joaquin River and the left bank of the Stanislaus River for the entire length of the site. Riparian forest grows between the river and the project levees, connecting to Caswell Memorial State Park along the Stanislaus River. Within the levees, and near the confluence with the Stanislaus River, some land is under cultivation. This land was formerly riparian forest according to 1914 CDC maps (ACOE 1917). Several oxbow lakes and Riley Slough were historically connected to the riparian system, and they are now separated from the river by the project levees. This site offers enormous potential for expansion of the San Joaquin River corridor. Incorporating this site into the NWR would connect the entire right bank floodplain of the San Joaquin River from the Tuolumne River downstream to the Stanislaus River, offering substantial flood storage and conveyance benefits, as well as waterfowl, fish, and wildlife habitats.

12.5.9.7. San Joaquin River RM 77 to 84 (Finnegan's Cut Area-Site 7)

This site extends along both banks of the San Joaquin River from Hwy132 to RM 86, approximately halfway between the confluence with the Tuolumne River and the town of Grayson. This portion of the river is characterized by an actively evolving channel with a very wide floodplain. The main river channel currently flows through Finnegan's Cut, and the historical San Joaquin channel is now abandoned. Numerous other sloughs, oxbows, and abandoned channels, with accompanying riparian forest vegetation, provide excellent wildlife habitat. Because of agricultural conversion and levee construction, many of the riparian forest patches are relatively narrow, containing willows, box elder, Oregon ash, Fremont cottonwood, and valley oak. Natural regeneration of many of these native species is occurring within the site. The channel at this site is partially contained within levees, most of which are local and protect agricultural fields in the floodplain. These fields were inundated by the 1997 flood, and incurred extensive damage. Many of the fields have not been farmed since then.

This site offers opportunities for both flood control and habitat enhancement, including reconnecting

the mainstem of the river to the floodplain by removing or breaching levees that protect agricultural fields, which would allow periodic inundation of more than 3,000 acres of land and allow temporary storage of floodwaters. There is little infrastructure in this area that would impede restoration efforts; the only significant structure is the intake for the West Stanislaus Main Canal.

12.5.9.8. San Joaquin River RM 84 to 92.5 (Laird Slough Area-Site 8)

This restoration site extends from the confluence of the Tuolumne and the San Joaquin rivers (RM 84) to the Brush Lake and Richie Slough area (RM 92.5). This reach actively meanders with abundant evidence of old and recent cutoffs. This area is highly agriculturally developed. Up to 400 acres of this site experienced levee breaches and sand splays during the 1997 flood. The width of riparian vegetation buffer is highly variable. Outside the levees, the active floodplain includes large tracts of uncultivated land, supporting valley oak woodland and mixed-willow riparian forest. Channel dynamics have allowed large pieces of habitat to develop, in particular between RM 87 and RM 89.5, where a mosaic of open water, wetlands, and riparian habitats persists. The site contains many ponds created by abandoned oxbows and sloughs, and presents several floodplain restoration opportunities.

If levees were to be set back in this area, some infrastructure would need to be protected or moved. Ring levees around farms and other buildings would be necessary. Roads may need to be raised, and bridge abutments may need to be reinforced. Building setback levees and removing or breaching existing levees and other infrastructure modifications would be expensive for this project.

12.5.9.9. San Joaquin River RM 92.5 to RM 99 (Site 9)

This site is along the San Joaquin River, from 0.5 mile downstream of the San Joaquin and Del Puerto Creek confluence (RM 92.8), to the Las Palmas Avenue Bridge. Project levees extend along almost the entire western side of the river, but they are set further back than at the upstream sites. The City of Modesto sewage disposal ponds are located on the historical right bank floodplain. Private levees extend along the left bank from RM92.5 to RM 92.8 and from RM 94 to RM 97. The area includes numerous abandoned sloughs and oxbow cutoffs. Extensive and diverse riparian and wetland vegetation extend to the west and northwest of the sewage ponds. On the left bank, the river has breached the private levees at several points and created extensive sand deposit areas on agricultural fields. Restoration opportunities in this reach mainly include expanding and protecting riparian habitat, reducing grazing pressure on grasslands and riparian areas, and setting back project and private levees.

12.5.9.10. San Joaquin River RM 99 to 107 (Site 10)

This restoration site is located along the San Joaquin River from the Las Palmas Avenue Bridge (RM 99) to the Crows Landing Bridge (RM 107). The site's width varies from 0.5 to 2 miles. Along the right bank of the river, the floodplain is narrowly confined by project levees, and the left bank of the river is flanked by a project levee. A short local levee extends from along the left bank from RM106.6 to RM 106.9. The left bank floodplain from RM 105.5 to RM 106.6 is confined by coalesced alluvial fans along the valley's west side. The site has numerous cutoff oxbows and dry swales. The higher and intermediate floodplain surfaces are drier than in the downstream reaches; Great Valley mixed riparian forest and black-willow stands are found along the abandoned oxbows and the riverbank. Recent floods have created low floodplain surfaces on high-water cutoff chutes and point bars. Willow scrub and herbaceous riparian wetland species are colonizing these recently created surfaces. Salt crusts and salt grass indicate that salinity may limit riparian regeneration at some locations. Natural vegetation remains on alternate bars, but agricultural fields have encroached between bars.

This site presents several restoration opportunities, including converting adjacent agricultural fields to riparian and wetland habitat, setting back project levees, removing riprap, and allowing the river channel to migrate into lands that are currently agricultural fields, and restoring riparian vegetation along a secondary channel between RM 105 and RM 106.5.

12.5.9.11. San Joaquin River RM 107 to 112 (Site 11)

This site is located along the San Joaquin River, from the Crows Landing Bridge at RM 107 to the Stanislaus–Merced County line at RM 112. The site includes approximately four complete meanders of the San Joaquin River and the confluence of the river with Orestimba Creek. Project levees extend along the entire right bank of the river. Outside bends along the right bank are located directly against the levee. To the west, the floodplain is confined by coalesced alluvial fans. Natural riparian vegetation is found within the point bars and along an abandoned slough east of the river. The floodplain is relatively arid with many chutes that have cut through the point bars, sand splay deposits, and active bars. The bend cutoff causes local sedimentation, where riparian vegetation can regenerate. An exception to the arid floodplain and sparse woody vegetation is the small Orestimba Creek confluence area, where a diversity of riparian forest in successional stages is found, with scrub and herbaceous wetland. A larger patch of riparian forest is found upstream of Crows Landing Bridge, where the slough channel was historically connected to the river.

Restoration opportunities for this site include (1) protecting and expanding riparian and marsh habitat at the Orestimba Creek confluence; (2) reestablishing connections of the abandoned slough channel with the river at high flows and converting agricultural fields along the channel to riparian habitat; (3) setting back the project levees along the right bank of the river and reestablishing a wider meander belt; and (4) removing local levees and bank armoring along the left bank.

12.5.9.12. Merced Slough: San Joaquin River RM 112 to 118 (Site 12)

This site extends from the Merced–Stanislaus County line at RM 112 to Hills Ferry Bridge at RM 118, downstream of the river’s confluence with the Merced River. The Merced Slough and an intermittent slough on the north are included in this restoration site. The site is part of a non-leveed floodway, with local levees from RM 112 to RM 113.5 and near RM 116. The northern portion of the Merced River’s alluvial fan is also included; meander scroll topography is extensive, and dry ridges alternate with wetter swales. The 1914 CDC maps show secondary channels on both sides of the San Joaquin River, particularly in the northern portion of the site. On both sides of the meander belt, some of the flood basins have been developed as duck ponds and rice fields. Several old oxbows are now relatively dry and have become Valley Oak stands. Great Valley mixed riparian forest is extensive on lower terraces near the channel. In bend cutoff chutes, several examples of willow and cottonwood regeneration were created by the flood of 1997. Previous floods have also created bar deposits and scoured areas (conducive to cottonwood regeneration) that are now patches of Great Valley cottonwood riparian forest.

This site provides the opportunity to protect the substantial riparian vegetation that remains, deepen secondary channels on the site to restore high-flow conveyance, restore historical flood basins to seasonal or permanent wetlands, and widen riparian corridors along slough connections between the Merced and San Joaquin Rivers.

12.5.10. Summary

Legislative acts, programs, committees, plans, and agencies have a common goal in the San Joaquin basin: to improve fish and wildlife habitat while recognizing constraints of irrigation, flood control, and domestic water supply. In some cases, restoration can be accomplished by changing operations or infrastructure. This chapter identified locations and circumstances where coordinated restoration opportunities could be found downstream.

12.5.10.1. Downstream Constraints

- Poor water quality in the lower river (see Chapter 6) is a potential constraint for Chinook salmon and steelhead, and numerous other native fish species. Nutrient concentrations in the lower San Joaquin River are high from concentrated inputs from agricultural drainage, wastewater-treatment plants, and runoff from dairies and feedlots. These high concentrations are diluted to some extent by varying inflows from the three major east-side tributaries. Regulated streamflows from the San Joaquin River and tributaries also contribute to increased water temperatures, which are also a constraint to salmonids.
- Entrainment of young salmon on their downstream migration into irrigation diversions can potentially occur at literally thousands of locations in the lower river and Delta;
- The stream channel and associated floodplain and riparian habitat have been severely degraded by channelization and floodplain development along the lower San Joaquin River. The degradation results in passage problems, high water temperatures, and limited rearing habitat for juvenile salmon migrating downstream from tributaries and the upper San Joaquin River.
- Water temperature is a constraint for salmon in the lower San Joaquin both in the fall when adults migrate upstream and in the spring when young are migrating downstream. High water temperatures may delay or block movement and increase mortality.
- Low fall flows in the lower river may impede adult upstream passage in some areas of the stream channel.
- Streamflow is a critical factor for salmon in the fall, winter, and spring particularly in dry years. Flow in the lower river is significantly related to subsequent survival to the Bay. Low flow leads to poor water quality, high temperatures, greater levels of entrainment into water diversions, increased predation, and constraints on passage
- Predation by striped bass, black bass, pikeminnow, and other predatory fish species in the lower river is a significant risk to salmon and steelhead restoration on the upper San Joaquin River. Populations of these native and non-native fishes have benefited from many of the habitat changes that have hurt salmon and steelhead.
- Hatchery production in the lower San Joaquin River tributaries could result in increased competition, predation, and potential loss of genetic integrity of San Joaquin basin salmon, and thus potentially constrain restoration of wild salmon stocks in the upper river.
- Downstream flood management continues to be seen by stakeholders of the lower San Joaquin River as a constraint to restoration from fears of increased floodplain overflows and restoration that may lead to increased downstream flooding potential.

12.5.10.2. Downstream Opportunities

- Water quality control and monitoring have been proposed along with pilot studies exploring solutions to specific water quality problems. Aerators are being considered to increase dissolved oxygen in the DWSC and Port of Stockton and a stakeholder-led effort has been developing a DO TMDL for the lower San Joaquin River within the Delta.
- The CALFED ERP, the AFRP, CDFG, and USBR Fish Screening Programs are working with local irrigation districts in the design and construction of fish screens. An example is the Banta-Carbona Fish Screen on the San Joaquin River. The Patterson Irrigation District has received funding to screen its intakes on the San Joaquin River.
- Conservation easements, channel reconfiguration, riparian vegetation, and floodplain restoration are being considered to improve habitats in the lower San Joaquin River for juvenile salmon that migrate through and may rear in this reach.
- The Stanislaus -Lower San Joaquin River Water Temperature Modeling and Analysis Project with funding support from CALFED will develop models for operating reservoir releases to improve water temperatures at critical times of the year for salmon migration. The Project will update existing water temperature and operation models for the tributaries and river.
- Proposed improvements to floodplain habitats and the river channel discussed in Section 12.5.9 are designed to improve fish habitat throughout the lower river.
- Flow management studies are being conducted by a number of Federal, State, and local agencies as part of FERC licensing, and CVP and CALFED. The Vernalis Adaptive Management Program and other CVPIA water programs, and the CALFED Environmental Water Account are being designed and tested to improve stream flow in the lower San Joaquin River and its tributaries.
- Hatchery programs that exist in the tributaries such as the Merced River Hatchery as well as other Central Valley hatcheries are undergoing reevaluation for improved management by State and Federal resource agencies responsible for maintaining and recovering wild salmon and steelhead stocks. Such scrutiny is already being planned by agencies involved in managing the San Joaquin River salmon resources.
- Federal funding provided through Natural Resources Conservation Service (NRCS) for acquisition of fee title or conservation easements and conversion to riparian habitats has been successful on the Tuolumne River in improving riparian habitats and a similar process could be implemented on the lower San Joaquin River.

12.6. LITERATURE CITED

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