CENTRAL VALLEY
FLOOD MANAGEMENT
PLANNING PROGRAM

FloodSAFE
CALIFORNIA

June 2012

2012 Central Valley Flood Protection Plan

A Path for Improving Public Safety, Environmental Stewardship, and Long-Term Economic Stability

Volume II
Attachment 7

DEPARTMENT OF WATER RESOURCES
STATE OF CALIFORNIA

PUBLIC SAFETY ENVIRONMENTAL STEWARDSHIP ECONOMIC STABILITY

Cover Photo: Sacramento Weir (December 23, 1964), DWR Photo Lab

The Sacramento Weir and Bypass discharges excess flows from the
Sacramento River (on the left) into the Yolo Bypass (not shown).
The 1964-65 water year was marked by one of the most disastrous floods in California's history.

2012 Central Valley Flood Protection Plan

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Attachment 7

Plan Formulation Report

CENTRAL VALLEY
FLOOD MANAGEMENT
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2012 Central Valley Flood Protection Plan

Attachment 7: Plan Formulation Report

June 2012

STATE OF CALIFORNIA
THE NATURAL RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

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1.0 Introduction

The purpose of this 2012 Plan Formulation reference document is to describe the plan formulation process for the Central Valley Flood Protection Plan (CVFPP). This section introduces the reference document and describes the 2012 CVFPP authorizing legislation and its requirements, the contents of the 2012 CVFPP, and the organization of this reference document.

1.1 Background and Plan Authority

The Central Valley has experienced some of the State of California's (State) largest and most damaging floods. The most recent significant floods in the Central Valley, which occurred in 1986 and 1997, together caused more than $1 billion in damage (USACE, 1997).

The existing flood management system in the Central Valley consists of a number of projects individually constructed over the last 150 years, including dams and reservoirs, levees, channels, weirs, bypasses, and other features that provide varying levels of flood protection. This system supports public safety, has prevented billions of dollars in flood damages in the Central Valley, and the system's multiple benefits have contributed to a vibrant California economy.

But today, much of this legacy flood management system is characterized by aging facilities built using outdated techniques, and the system is being relied on to provide benefits that were not envisioned when its elements were first constructed. Also, along many reaches of river in the system, ecosystem functions and natural habitats have been severely degraded over time. As currently configured, the system is prone to erosive river forces, is easily distressed from high water, and does not support healthy ecosystem functions and natural floodplain habitats. Further, because of limited funding and other constraints, State and local agencies have found it increasingly difficult to carry out adequate flood management system maintenance programs. At the same time, escalating development in Central Valley floodplains has increased the population at risk from flooding and the potential for flood damages to homes, businesses, communities, and critical statewide facilities.

Despite the protection provided by the current flood management system, residual flood risk in the Central Valley remains among the highest in the country. Currently, even small flood events with only a 5 percent annual chance of occurrence can stress parts of the flood management system.

A combination of recent events, including flooding related to Hurricane Katrina in New Orleans and recent flooding along the Mississippi River and its tributaries, has highlighted the vulnerability of the Central Valley to catastrophic floods, the potential consequences to life and property (particularly in deep floodplains), and possible impacts to the financial stability of the State.

In fall 2007, the California Legislature passed five interrelated bills aimed at addressing the problems of flood protection and flood damage liability. These bills included Senate Bill (SB) 5, SB 17, Assembly Bill (AB) 5, AB 70, and AB 156. Primary authorization for the CVFPP originates in SB 5, also known as the Central Valley Flood Protection Act of 2008.[1] In addition, the Disaster Preparedness and Flood Prevention Bond Act (Proposition 1E) and the Safe Drinking Water, Water Quality and Supply, Flood Control Protection Bond Act (Proposition 84) provide both specific and general authority for related State flood management efforts. AB 162, another flood-related bill passed in 2007, required additional consideration of flood risk in local land-use planning throughout California. These bills added or amended sections in the California Government Code (CGC), Health and Safety Code, Public Resources Code (PRC), and California Water Code[2] (CWC), and included specific requirements for developing the CVFPP. The 2007 flood-related legislation and plan authority are further discussed in Section 1.2.

In 2008, the California Department of Water Resources (DWR) embarked on the Central Valley Flood Management Planning (CVFMP) Program, a long-term planning effort to improve integrated flood management within the Central Valley, and carry out direction from the California Legislature. DWR, in collaboration with the U.S. Army Corps of Engineers (USACE), was required to prepare a sustainable,[3] integrated flood management[4] plan called the CVFPP by January 1, 2012. The 2012 CVFPP is to be considered and adopted by the Reclamation Board (now the Central Valley

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[1] More detailed information on authority and guidance is included in Chapter 1 of the draft *Regional Conditions Report – A Working Document* (DWR, 2010b).

[2] Relevant code sections are highlighted in the *2007 Flood Legislation Summary* (DWR, 2007a) and *2007 Flood Legislation Companion Reference* (DWR, 2007b).

[3] A project is considered “sustainable” when it is socially, environmentally, and financially feasible for an enduring period.

[4] Integrated flood management is an approach to flood risk that recognizes the interconnection of flood management actions within broader water resources management and land use planning; the value of coordinating across geographic and agency boundaries; the need to evaluate opportunities and potential impacts from a system perspective; and the importance of environmental stewardship and sustainability (DWR, 2008a).

Flood Protection Board (Board)). The Board is directed to adopt the 2012 CVFPP no later than July 1, 2012. The CVFPP outlines a systemwide approach to protecting lands currently protected from flooding by existing facilities of the State Plan of Flood Control[5,6] (SPFC), and will be updated every 5 years thereafter (in years ending in 7 and 2).

1.1.1 FloodSAFE California

The 2012 CVFPP is being developed under DWR's FloodSAFE California (FloodSAFE), a multifaceted and collaborative, long-term statewide initiative to improve public safety through integrated flood management. FloodSAFE uses a systemwide approach to flood management, while reducing flood risk at regional and local levels.

DWR and the Board will provide leadership, through FloodSAFE and work with State, federal, tribal, local and regional officials to improve emergency response, improve flood management systems, improve operations and maintenance (O&M), and inform the public about flood preparedness and safety.

FloodSAFE will coordinate flood management efforts so that (1) the 2012 CVFPP and its future updates contain the best available information and inputs from other FloodSAFE projects and programs, and (2) existing and ongoing FloodSAFE functions and funding mechanisms are efficiently used to help implement 2012 CVFPP recommendations.

DWR is implementing various aspects of FloodSAFE using funds from Proposition 1E and Proposition 84, with direction from the 2007 flood legislation. It is recognized that funding provided by Propositions 1E and 84 will not be sufficient to realize all of the envisioned improvements to flood management in the Central Valley; these improvements will take many years to complete. Successful implementation of FloodSAFE and the 2012 CVFPP will require additional, sustainable funding streams for improvement projects and core flood management functions such as inspections and O&M.

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[5] CWC Section 8523 defines the SPFC as the State and federal flood control works, lands, programs, plans, conditions, and mode of maintenance and operations of the Sacramento River Flood Control Project (CWC Section 8350) and flood control projects in the Sacramento River and San Joaquin River watersheds (river basins) for which the Board or DWR has provided assurances, and of those facilities identified in CWC Section 8361.

[6] The assurances (satisfactory to the Secretary of War) are that the State will provide, without cost to the United States, all lands, easements, and rights-of-way necessary for the completion of the project; bear the expense of necessary highway, railroad, and bridge alterations; hold and save the United States free from claims for damages resulting from construction of the works; and maintain and operate all works after completion.

1.2 Central Valley Flood Protection Plan Requirements

As discussed previously, primary authorization for the 2012 CVFPP originates in SB 5. In addition, Propositions 1E and 84 provide both specific and general authority for related State flood management efforts. SB 5 and SB 17, and AB 5, AB 70, and AB 156 added or amended sections in the CGC, Health and Safety Code, PRC, and CWC, and included specific requirements for developing the 2012 CVFPP.

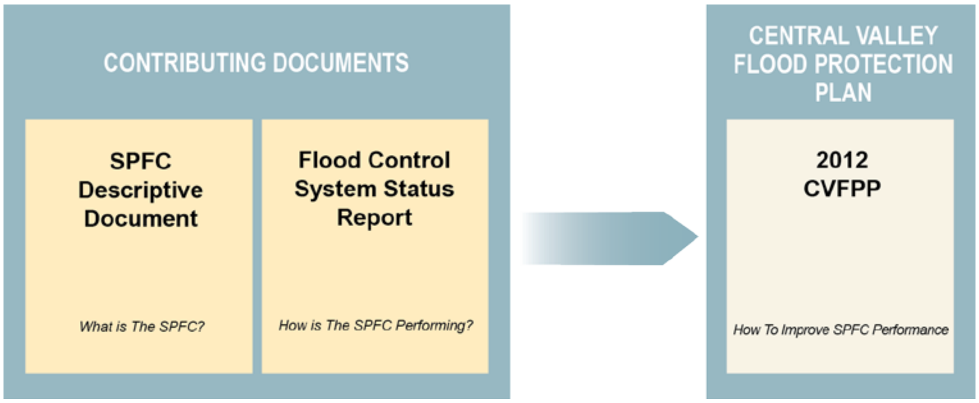
Several documents are being prepared to collectively meet the intent and requirements of the 2007 flood-related bonds and legislation. CVFPP Attachment 1: Legislative Reference contains more detailed information related to the requirements and how they have been satisfied. The 2012 CVFPP contributes to meeting the bond and legislation requirements.

The 2007 flood-related legislation also require cities and counties in the Sacramento-San Joaquin Valley to incorporate consistent information from the 2012 CVFPP into their local land-use plans after the 2012 CVFPP is adopted. Cities and counties that do not comply with these and other related requirements may be subject to restrictions when approving new development in urban and urbanizing areas.

The 2012 CVFPP seeks to prioritize State investments to most effectively advance the State interest in flood risk reduction. Investments will focus on the long-term sustainability of the flood management system as a whole, rather than on a project-by-project basis, with consideration for the value of environmental and agricultural stewardship in the Central Valley.

As required by the legislation, the CVFPP is to be updated every 5 years, with the first update to occur in 2017. DWR anticipates that updates will incorporate new and revised information and also that goals and actions will be reviewed and realigned as specific projects are implemented and conditions evolve in the Central Valley. Additional activities, such as local and regional studies, federal feasibility studies, and investigations of environmental integration activities, will occur to support implementation of physical elements or features of the CVFPP. As specific projects are undertaken, environmental review and detailed design will be carried out to meet legal requirements.

To meet legislative requirements, the following documents were, or are in the process of being, developed in addition to and in support of the 2012 CVFPP (Figure 1-1).



Key
CVFPP = Central Valley Flood Protection Plan
SPFC = State Plan of Flood Control

Figure 1-1. Contributing Documents

- The *State Plan of Flood Control Descriptive Document* (Descriptive Document) (DWR, 2010a) complies with Proposition 1E, which requires that information on the SPFC "…be updated by department and compiled into a single document…" and inform development of the 2012 CVFPP. The Descriptive Document (DWR, 2010a) provides an inventory of flood management projects and works (facilities), lands, programs, plans, conditions, and mode of O&M for the State-federal flood protection system in the Sacramento River and San Joaquin river basins of California. The Descriptive Document is the first inventory of the SPFC compiled or referenced in a single report. The report is structured as a reference document for the SPFC and includes narrative descriptions, tables, and figures, especially maps, to help the reader find information about this complex flood protection system.

- The *Flood Control System Status Report* (FCSSR) (DWR, 2011a) was created to comply with CWC Section 9120 and to contribute to CVFPP development. The FCSSR describes the current status (physical condition) of SPFC facilities at a systemwide level. The FCSSR is primarily intended to present information on the physical condition of SPFC facilities, and to help guide future inspection, evaluation, reconstruction, and improvement of the facilities.

- A *Program Environmental Impact Report* (PEIR) (DWR, anticipated 2012) is being prepared by DWR under the California Environmental Quality Act (CEQA) to facilitate Board adoption of the 2012 CVFPP. Completion is expected in 2012. The report analyzes the broad potential impacts associated with adopting the CVFPP, at a program scale. Subsequent implementation actions stemming from adoption of the CVFPP will likely require project-level environmental review for CEQA compliance. Per agreement with the Board, DWR will act as lead agency and be responsible for compliance with CEQA requirements and guidelines, and for certifying the PEIR. As a responsible agency, the Board will independently consider the findings in the PEIR, and reach its own conclusions related to adoption of the 2012 CVFPP.

Collectively, this body of work fulfills the intent and requirements of the Central Valley Flood Protection Act of 2008, embedded in SB 5 (2007) and codified in Sections 9616 through 9625 of the CWC.

1.3 Contents of Central Valley Flood Protection Plan

Contents of the 2012 CVFPP include the following:

- Responding to the need for improved flood management in the Central Valley
- Preliminary approaches
- State Systemwide Investment Approach (SSIA)
- Implementing and managing the SSIA

As discussed above, DWR has prepared or is preparing several plan-related studies to collectively fulfill the legislative mandate described above. Similar to the 2012 CVFPP, these documents were or are being developed using a collaborative planning process involving interested parties. The 2012 CVFPP and its supporting documents contain the following to meet the requirements of CWC Section 9614:

- Description of the Sacramento-San Joaquin River Flood Management System and the cities and counties included in the system
- Description of the system performance and the challenges to modifying the system to provide appropriate levels of flood protection using available information
- Description of the facilities included in the SPFC, including all of the following:
    - Precise location and a brief description of each facility; a description of the population and property protected by the facility; system benefits provided by the facility, if any, and a brief history

of the facility, including the year of construction; improvements to the facility; and any failures of the facility

- Design capacity of each facility

- Description and evaluation of the performance of each facility, including the following:
  - An evaluation of failure risks due to each of the following:
    - Overtopping
    - Under-seepage and through-seepage
    - Structural failure
    - Other sources of risk, including seismic risks, that DWR or the Board determines are applicable
  - Description of any uncertainties regarding performance capability, including uncertainties arising from the need for additional engineering evaluations or uncertainties arising from changed conditions, such as changes in estimated channel capacities
- Description of each existing dam that is not part of the SPFC that provides either significant systemwide benefits for managing flood risks within the Sacramento and San Joaquin river basins, or protects urban areas within the Sacramento and San Joaquin river basins
- Description of each existing levee and other flood management facility that is not part of the SPFC and that provides either significant systemwide benefits for managing flood risks within the Sacramento and San Joaquin river basins, or protects urban areas within the Sacramento and San Joaquin river basins
- Description of the probable impacts of projected climate change, projected land-use patterns, and other potential flood management challenges on the ability of the system to provide adequate levels of flood protection
- Evaluation of the structural improvements and repairs necessary to bring each SPFC facility to within its design standard, including a prioritized list of recommended actions

- List of facilities (included in the evaluation) recommended to be removed from the SPFC. For each facility recommended for removal, the evaluation will identify both of the following:
    - Reasons for proposing removal of the facility from the SPFC
    - Any additional recommended actions associated with removing the facility from the SPFC
- Description of structural and nonstructural methods for providing an urban level of flood protection to current urban areas. The description will also include a list of recommended next steps to improve urban flood protection
- Description of structural and nonstructural means for enabling or improving systemwide riverine ecosystem function, including, but not limited to, establishing riparian habitat and seasonal inundation of available floodplains, where feasible

The 2012 CVFPP focuses on improving integrated flood management and flood protection for areas protected by SPFC facilities. While the CVFPP focuses on areas protected by SPFC facilities, the O&M of facilities in tributary watersheds that influence SPFC-protected areas are also considered.

The 2012 CVFPP recognizes the connection of flood management actions to water resources management; land-use planning; environmental stewardship; and long-term economic, environmental, and social sustainability. Integrated flood management also recognizes the importance of evaluating opportunities and potential impacts from a systemwide perspective, and the importance of coordinating across geographic and agency boundaries to treat entire hydrologic units.

The 2012 CVFPP provides opportunities to mitigate some of the negative effects of current trends while promoting wise investments of State, federal, and local funds:

- The 2012 CVFPP will emphasize wise floodplain management, which, in concert with the Federal Emergency Management Agency (FEMA) National Flood Insurance Program, will limit excessive floodplain development and promote the continued sustainability of the current rural-agricultural economy and small communities in the Central valley.

- Investments in levees and other flood protection infrastructure will be considered on a systemwide basis. It is likely that urban communities with the greatest concentrations of population and damageable property will continue to receive the greatest share of available State and federal funds. However, the 2012 CVFPP gives careful attention to repairing known weaknesses in the rural-agricultural levee system and also protecting small communities. Because rural-agricultural areas are less developed, the State is interested in seeing more nonstructural improvements, as these often can have lower long-term annual O&M costs and higher system benefits. With this in mind, the 2012 CVFPP provides a framework for a much broader benefit analysis than the traditional approach, which relies almost entirely on the benefit-to-cost ratio and net economic development indicators to guide investments. The 2012 CVFPP considers potential system improvements, such as expanded bypasses and associated ecosystem enhancements, which are beyond the sponsorship capabilities of even the most robust local agencies.

- The 2012 CVFPP proposes to take an integrated system approach to flood system maintenance and ecosystem restoration. In practice, this means developing more extensive and robust wildlife habitat along the Central Valley flood management system, such that periodic maintenance, which temporarily disrupts habitat, is compensated for by acreage of appropriate and connected habitat, improved maintenance techniques, and other tools.

- The 2012 CVFPP focuses on implementation of an integrated system approach to flood management programs and considers the sequential phasing of incremental elements of the programs. This approach relies on development of a firm technical foundation to inform implementation actions in future CVFPP phases, with an initial focus on the most urgent flood management system needs. It also supports development of a sound funding strategy to pursue effective, long-term flood management in the Central Valley.

1.4 Report Organization

The purpose of this reference document is to describe the plan formulation process, including the SSIA, for the 2012 CVFPP. This document is organized into the following sections:

Section 1 (Introduction) provides context for this reference document, background and plan authority, CVFPP requirements, and contents of the 2012 CVFPP.

Section 2 (Plan Development) describes the plan development process, planning area, anticipated uses of the CVFPP, and studies and reports related to the CVFPP.

Section 3 (Systemwide Conditions) discusses existing systemwide conditions, including environmental, physical, social and economic, and policy and institutional conditions. The section also discusses likely future systemwide conditions through 2050 and the key drivers and influencing factors of likely changes.

Section 4 (Flood and Related Resource Problems) discusses environmental, physical, social and economic, and policy and institutional problems.

Section 5 (Goals, Principles, and Objectives) discusses FloodSAFE and CVFPP goals and their relationship, CVFPP guiding principles, and legislative and planning objectives.

Section 6 (Management Actions) identifies management actions, describes preliminary evaluation and consolidation of management actions, and summarizes management actions carried forward.

Section 7 (Preliminary Approaches) describes the preliminary approach formulation process for No Project, Achieve SPFC Design Flow Capacity Approach, Protect High-Risk Communities Approach, and Enhance Flood System Capacity Approach; evaluates and compares accomplishments; and summarizes findings.

Section 8 (State Systemwide Investment Approach) describes the elements and selection of the SSIA, including formulation, systemwide concepts, regional elements, performance of the approach, and the investment strategy. This approach is compared to No Project based on estimated costs, benefits, completeness, effectiveness, efficiency, and acceptability.

Section 9 (Local and Regional Project Summaries) summarizes local and regional projects in the Systemwide Planning Area.

Section 10 (References) lists sources referenced in preparation of this reference document.

Section 11 (Acronyms and Abbreviations) lists the acronyms and abbreviations used in this reference document.

2.0 Plan Development

This section describes the plan development process, planning area, anticipated uses of the CVFPP, and related studies and reports.

2.1 Plan Development Process

The 2012 CVFPP was developed using an iterative planning process. Extensive public engagement occurred as part of Phases 1 and 2. Originally outlined in four phases, the concluding phases of CVFPP development (Phases 3 and 4) were redefined and streamlined based on input from partners and interested parties (Figure 2-1).

Figure 2-1. Planning Process for 2012 Central Valley Flood Protection Plan Development

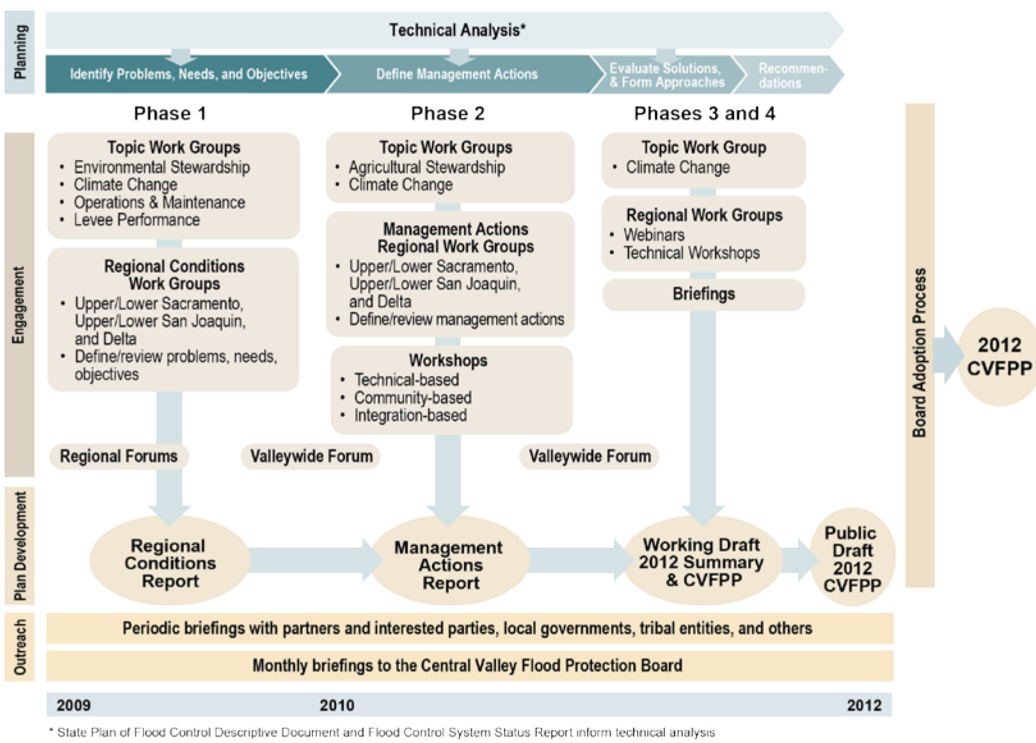
Concurrent with public engagement, DWR gathered systemwide data and conducted evaluations for the SPFC. DWR also (1) prepared a PEIR documenting environmental impacts associated with the CVFPP, and (2) performed supporting technical analyses related to hydrology, reservoir operations, riverine and estuarine hydraulics, levee system performance, economic flood damages, life risk, regional economics, cost estimates, climate change, and groundwater recharge.

Results of these efforts contributed to developing three preliminary approaches to improving the flood management system, and ultimately an SSIA.

2.1.1 Public Engagement Process

DWR initiated an extensive communications and public engagement process for the 2012 CVFPP by reaching out to partnering agencies, interested parties, and the public, allowing them to share and solicit information and offer input and recommendations. The intent was to facilitate open communication and provide opportunities to participate in CVFPP development in a variety of ways, depending on interest and availability of potential stakeholders. Outreach activities, including outreach to Native American tribes and disadvantaged communities, are detailed in Attachment 5: Engagement Record.

A comprehensive, multiphase, public engagement planning process was essential in developing the CVFPP. Figure 2-2 depicts the phases and major components of the engagement process. In addition, all public engagement activities are detailed in Attachment 5: Engagement Record.



Key:
Board = Central Valley Flood Protection Board
CVFPP = Central Valley Flood Protection Plan

Figure 2-2. Communication and Public Engagement Process

The four phases of CVFPP public engagement were completed as follows:

- **Phase 1 –** Defined existing conditions and likely future challenges; identified problems from various perspectives; and defined goals, principles, and objectives to guide development and implementation of the plan. Results from this planning phase are described in the *Regional Conditions Report – A Working Document* (RCR) (DWR, 2010b) and summarized in *Interim Progress Summary No. 1* (DWR, 2010c).

- **Phase 2 –** Identified a broad range of potential structural and nonstructural management actions for meeting the plan's objectives, consistent with the guiding principles, and defined evaluation methods and screening criteria to be applied. Results from this phase were summarized in the *Management Actions Report* (DWR, 2010d) and *Interim Progress Summary No. 2* (DWR, 2010e).

- **Phases 3 and 4 –** Phases 3 and 4 were combined to become the final phase of plan development. Following development of individual management actions, three preliminary approaches were formulated to reduce the number of possible combinations of individual management actions. Finally, an SSIA was developed that incorporates the most promising features and elements of each of the preliminary approaches.

For the 2012 CVFPP, flood and related resource problems were identified from input provided by State, federal, regional, local, and tribal interests. Many of these interested parties participated in planning area work groups and/or topic work groups convened to help articulate existing resource conditions for the 2012 CVFPP; flood and related resource problem identification was an important output of those meetings. The public engagement process is described in detail in Attachment 5: Engagement Record.

2.1.2 Systemwide Documentation and Technical Analyses

DWR gathered systemwide data and conducted evaluations for the SPFC to meet specific legislative requirements, and support CVFPP development concurrent with public engagement. A PEIR was prepared documenting environmental impacts associated with the CVFPP, and supporting technical analyses were performed and documented. Additional detail and reference information for supporting documents are provided in Section 2.4. Information from these efforts contributed to CVFPP plan development, as follows:

- **Existing Conditions (Section 3) –** *SPFC Descriptive Document* (DWR, 2010a), RCR (DWR, 2010b), PEIR, Attachment 8: Technical Analysis Summary Report

- **Flood and Related Resource Problems (Section 4) –** RCR (DWR, 2010b), FCSSR(DWR, 2011a), PEIR, Attachment 2: Conservation Framework, Attachment 8: Technical Analysis Summary Report

- **Goals, Principles, and Objectives (Section 5) –** RCR (DWR, 2010b), Attachment 2: Conservation Framework, Attachment 8: Technical Analysis Summary Report, Implementation

- **Management Actions (Section 6) –** *Management Actions Report* (DWR, 2010d), Attachment 2: Conservation Framework, Attachment 8: Technical Analysis Summary Report

- **Preliminary Approaches (Section 7) –** PEIR; Attachment 2: Conservation Framework, Attachment 8: Technical Analysis Summary Report

- **State Systemwide Investment Approach (Section 8) –** PEIR, Attachment 2: Conservation Framework, Attachment 8: Technical Analysis Summary Report

2.2 Planning Area

Two relevant geographic areas are relevant to CVFPP development:

- SPFC Planning Area
- Systemwide Planning Area

Both planning areas are shown in Figure 2-3. The SPFC Planning Area is a geographic area that includes lands currently receiving protection from flooding by facilities of the SPFC. The State's flood management responsibility is limited to the SPFC Planning Area. The SPFC Planning Area is best delineated by Levee Flood Protection Zone (FPZ) maps (DWR, 2008c), and the area inundated by the only SPFC reservoirs, Lake Oroville and Castle Lake (Merced County).

The Systemwide Planning Area is the geographic area that includes lands currently subject to flooding and receiving protection from facilities and operation of the Sacramento-San Joaquin River Flood Management System. This area includes facilities that provide significant systemwide benefits (such as reservoirs on major tributaries) or that protect urban areas within the Sacramento-San Joaquin Valley. The SPFC Planning Area is completely contained within the Systemwide Planning Area. After floodplain delineation work under the Central Valley Flood Evaluation and Delineation Program concludes, updated floodplains will be available for refining the Systemwide Planning Area.

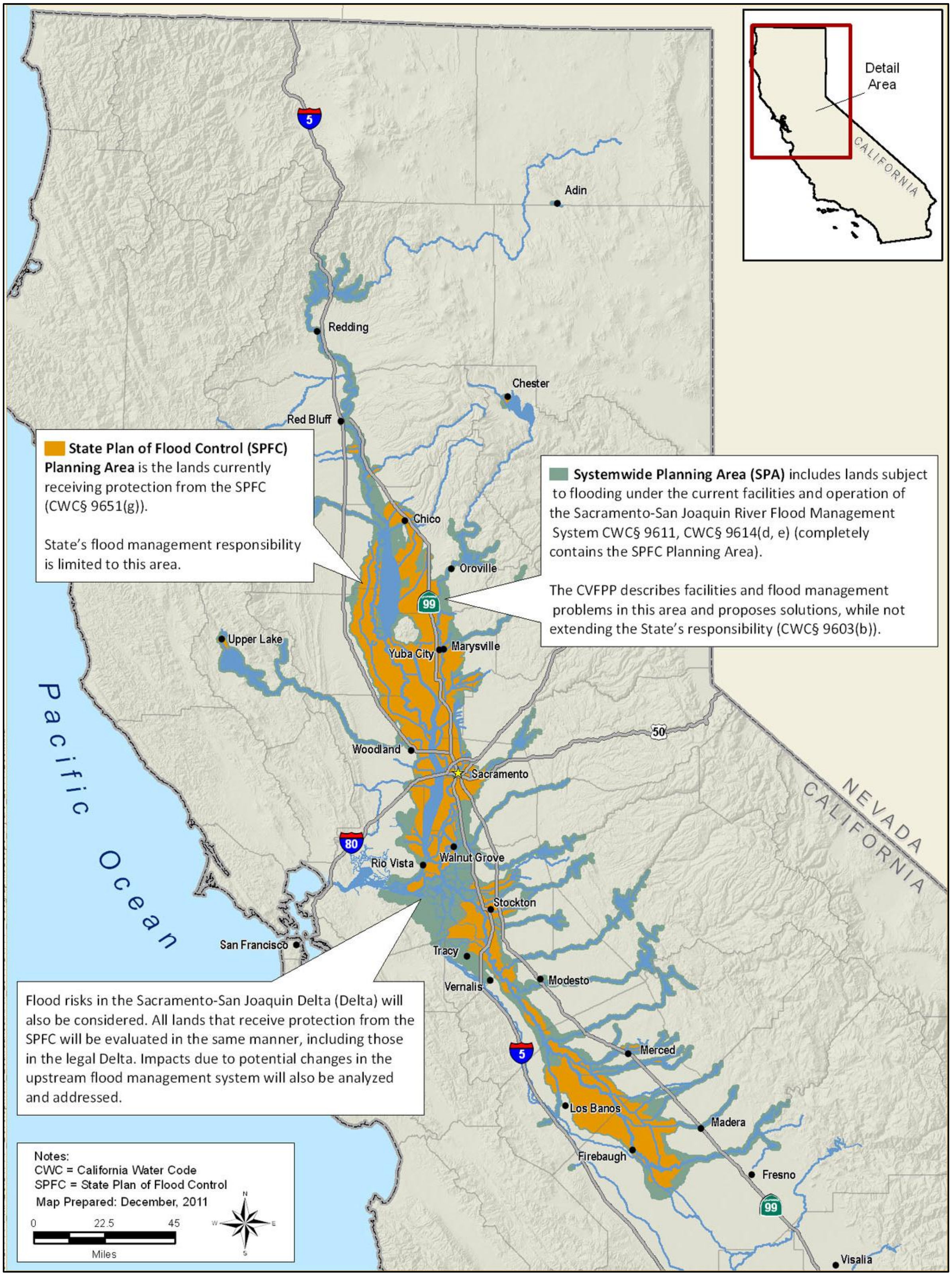


Figure 2-3. Geographic Scope of Central Valley Flood Protection Plan

The Systemwide Planning Area is delineated through a combination of the currently available floodplain information:

- Sacramento and San Joaquin River Basins Comprehensive Study (Comprehensive Study) (USACE, 2002) 500-year floodplain, with an update from the American River Common Features General Reevaluation Report (USACE, 2010)

- Comprehensive Study (USACE, 2002) 200-year floodplain along the Sacramento River from Redding to Red Bluff. Floodplain was prepared by the DWR Northern District for the Comprehensive Study (USACE, 2002) to supplement floodplain information outside the Comprehensive Study's (USACE, 2002) unsteady flow through a network of open channels (UNET) model

- Draft FPZ maps, currently defined as showing areas that could be inundated should a project levee fail while water is flowing in a channel at maximum reasonable capacity. (These inundation areas do not have a uniform flood frequency association.)

- Information on Sacramento-San Joaquin Delta (Delta) boundary

For the Systemwide Planning Area (including the SPFC Planning Area), the CVFPP does the following:

- Describes key components of the Sacramento-San Joaquin Flood Management System

- Identifies and describes existing and future systemwide conditions, flood and related resource problems, goals, principles, and objectives for the Systemwide Planning Area that will guide the formulation, evaluation, and recommendation of potential solutions

- Identifies, packages, and evaluates all potentially useful management actions[7] to achieve the goals and objectives of the CVFPP. Potential management actions can be physically located either within or outside the boundary of the Systemwide Planning Area, but all management actions of the CVFPP will be designed to produce benefits within the Systemwide Planning Area

In addition to the planning areas, the Sacramento and San Joaquin river basins were divided into five smaller regions, as shown in Figure 2-4, for

[7] Management actions include all structural and nonstructural activities or projects that could be undertaken to improve flood management within the designated planning area.

the purposes of data collection and public engagement with partners and interested parties.

- **Upper Sacramento River Region –** Sacramento River above the Fremont Weir, including the Sutter Bypass to its confluence with the Feather River.
- **Lower Sacramento River Region** – Feather River from its confluence with the Sutter Bypass and Sacramento River downstream from the Fremont Weir, including the Feather, Yuba, and American river basins.
- **Upper San Joaquin River Region –** San Joaquin River upstream from the Merced River confluence, including the Merced River basin.
- **Lower San Joaquin River Region –** Joaquin River downstream from the Merced River confluence.
- **Delta Region –** Legal Delta, as defined in CWC Section 12220.

2.3 Anticipated Uses of Central Valley Flood Protection Plan

The CVFPP guides a variety of follow-on studies and planning efforts, environmental reviews, and implementation actions. It may be used differently by State, federal, regional, and local agencies, as described briefly below.

2.3.1 State Use of Central Valley Flood Protection Plan

The CVFPP recommends potential State actions to directly or indirectly improve flood risk management in the Central Valley. Neither development nor adoption of the CVFPP represents a commitment by the State to provide or to maintain any particular level of flood protection (CWC Section 9603(a)). State participation in implementing flood protection may range from leadership in project development and financial assistance to technical support. State agencies may also pursue recommended changes to policies, standards, or regulations, as appropriate to their existing authorities.

Figure 2-4. Planning Regions for Data Collection and Public Engagement

For example, DWR may participate in recommended follow-on feasibility studies, or pursue improvements to its core flood management functions (such as O&M or emergency response). The CVFPP will also help define DWR's role in future improvement projects, including risk assessments, urgent repairs, and local and regional projects. DWR is currently developing criteria for local agencies to use in demonstrating an urban level of flood protection for urban and urbanizing areas, pursuant to CWC Section 9602. After adoption of the plan, DWR will continue to provide technical assistance to local jurisdictions in applying these criteria and aligning local planning efforts with the CVFPP.

After adoption of the 2012 CVFPP, the Board may choose to take action within its existing jurisdictional and regulatory capacities. Adoption of the plan by the Board will trigger various existing requirements related to local land-use planning and management (see Local and Regional, below).

Other State agencies may also choose to take action within their existing jurisdictional roles and responsibilities based on information in the CVFPP.

2.3.2 Federal Use of Central Valley Flood Protection Plan

In mutual recognition of the importance of close collaboration and coordination on Central Valley flood risk reduction measures, USACE is conducting a parallel planning process, the *Central Valley Integrated Flood Management Study* (CVIFMS) (currently under development), with DWR and the Board as the nonfederal sponsors. Scheduled to be completed in 2017, this program-level feasibility study will complement the CVFPP. It will define a long-range flood management program for the Sacramento and San Joaquin river basins and a corresponding level of federal participation. In relation to the CVFPP, the study will also evaluate flood management improvements in the Central Valley from a federal perspective, and help determine federal interest in implementation. USACE intends to coordinate closely on CVFPP development to provide input, review documents, and produce joint data, information, and analytical tools. USACE will also provide technical expertise on flood hydrology development, reservoir operations analyses, and incorporation of risk-based decision-making processes that improve system reliability.

The CVIFMS may result in Congressional action authorizing or modifying federal participation in projects consistent with the CVFPP. The CVFPP may influence federal actions or provide information to ongoing or new USACE feasibility studies evaluating site-specific improvements to the flood management system.

The CVFPP is unlikely to directly influence current activities of FEMA, such as administration of the National Flood Insurance Program. However, the CVFPP may recommend changes to the scope or administration of federal programs related to flood risk management.

2.3.3 Local and Regional Use of Central Valley Flood Protection Plan

Adoption of the 2012 CVFPP will trigger various requirements related to local land-use planning and management. These requirements oblige local jurisdictions to consider flood risk and flood management in their planning and decision making (such as general plans, zoning ordinances, development agreements, and other discretionary actions), concurrent with development of the 2012 CVFPP and after its adoption by the Board. Local jurisdictions may use information or guidance contained in the CVFPP to demonstrate consistency with State urban flood protection requirements, or to guide development of local or regional flood projects consistent with the CVFPP to garner State financial participation.

2.4 Studies and Reports Related to Central Valley Flood Protection Plan

Development of the 2012 CVFPP includes work to achieve various planning milestones, environmental review activities, communication and engagement with partners and interested parties, technical analyses and data collection, and related efforts. Key planning milestones completed include developing documentation related to the SPFC; defining flood and related resource problems; and identifying goals, guiding principles, objectives, and management actions.

As a companion effort to the CVFPP, DWR is developing a *Central Valley Flood System Conservation Strategy* (CVFSCS), which is a long-term strategic approach for DWR to (1) achieve the environmental goals and objectives of the Central Valley Flood Protection Act, FloodSAFE Initiative, and CVFPP; (2) implement the environmental stewardship policy; and (3) address public environmental expectations. The goal is to integrate environmental stewardship into flood system planning and ongoing O&M. Supporting environmental enhancement as a primary planning objective has the added benefit of reducing environmental regulatory compliance issues for projects and/or operations, which then benefits DWR through increased regulatory agency support, reduces costs in project development, and reduces time frames for implementing actions. Integrating environmental stewardship in the project conception and design phase creates the opportunity to develop a project that is more sustainable and cost effective, and that will provide ecological benefits and protect water supply and public safety. Performing initial planning for development of the CVFSCS is a key milestone for development of the CVFPP.

The CVFSCS is a long-term strategic effort that will evolve as the CVFPP is updated every 5 years. The first phase of the CVFSCS is the Conservation Framework, discussed in detail in Attachment 2: Conservation Framework. The Conservation Framework is a preview of the CVFSCS and an environmental guide for the CVFPP reader. It describes how environmental stewardship is integrated, directs the reader to relevant environmental elements, and provides environmental detail in the text and through technical supporting documentation. In some cases, conservation strategy elements may not be identified separately if the planning process is successful at integrating environmental stewardship. For example, restoration opportunities identified through the Conservation Framework Restoration Opportunity Analysis would be integrated into the SSIA.

Activities in progress now to support development of the long-term CVFSCS will continue past completion of the 2012 CVFPP and lead to completion of the long-term CVFSCS to coincide with and support the 2017 update of the CVFPP. By the 2017 update of the CVFPP, the CVFSCS will be fully developed and will complement the CVFPP and the federal CVIFMS.

Several other documents have been completed or are under preparation to meet the legislative requirements of CWC Section 9120, as previously mentioned. These documents informed the planning process for the CVFPP. They are separate, but complementary, documents in different phases of development.

Table 2-1 summarizes companion documents to the CVFPP that have been developed or are currently under development.

Table 2-1. CVFPP Companion Documents

Name	Reference
CVFPP Program Environmental Impact Report	DWR, 2012a
CVFPP Progress Report	DWR, 2011b
State Plan of Flood Control Descriptive Document	DWR, 2010a
Flood Control System Status Report	DWR, 2011a
Management Actions Report	DWR, 2010d
Regional Conditions Report – A Working Document	DWR, 2010b
Urban Levee Design Criteria	DWR, 2012b
Draft Urban Level of Flood Protection Criteria	DWR, 2012c
Attachment 1: Legislative Reference	2012 CVFPP
Attachment 2: Conservation Framework	2012 CVFPP
Attachment 3: Documents incorporated by Reference	2012 CVFPP
Attachment 4: Glossary	2012 CVFPP
Attachment 5: Engagement Record	2012 CVFPP
Attachment 6: Contributing Authors	2012 CVFPP
Attachment 7: Plan Formulation Report	2012 CVFPP
Attachment 8: Technical Analysis Summary Report	2012 CVFPP

Key:
CVFPP = Central Valley Flood Protection Plan
DWR = California Department of Water Resources

Table 2-2 summarizes USACE studies, FloodSAFE documents, and other State or federal plans and studies related to the CVFPP.

Table 2-2. Documents and Ongoing Studies Related to 2012 CVFPP

Name	Authorizing Agency
American River Common Features General Reevaluation Report	USACE
Bay-Delta Conservation Plan	DWR
California Water Plan	DWR
Central Valley Integrated Flood Management Study	USACE
Delta Islands and Levees Feasibility Study	USACE
Delta Risk Management Strategy	DWR
Delta Plan	Delta Stewardship Council
FloodSAFE Implementation Plan	DWR
FloodSAFE Revised Economic Impact Analysis of the Proposed Mandatory Building Code Update for Single-Family Residential (R-3 and R-3.1) and Educational (E) Occupancy Groups	DWR
FloodSAFE Strategic Plan	DWR
Levee System Integrity Program	DWR
Lower Cache Creek General Investigation	USACE
Lower San Joaquin River Feasibility Study	USACE
Merced County Streams Feasibility Study and General Reevaluation Report	USACE
Rock Creek/Keefer Slough Feasibility Study	USACE
Sacramento-San Joaquin River Basins Comprehensive Study	USACE
Sacramento River Bank Protection Project – Phase II Supplemental Authorization	USACE
Sacramento River Bank Protection Project – Phase III	USACE
San Joaquin River Restoration Program	Reclamation
Sutter Basin Feasibility Study	USACE
West Sacramento Area Flood Control Agency Project and General Reevaluation Report	USACE
West Stanislaus County/Orestimba Creek Feasibility Study	USACE
Yuba River Basin Project General Reevaluation Report	USACE

Key:
CVFPP = Central Valley Flood Protection Plan
DWR = California Department of Water Resources
Reclamation = U.S. Department of Interior, Bureau of Reclamation
USACE = U.S. Army Corps of Engineers

3.0 Systemwide Conditions

This section provides an overview of existing and future systemwide conditions in the SPFC and Systemwide Planning Areas. More detailed information can be found in the plan-related and reference documents listed in Section 2.4.

3.1 Existing Systemwide Conditions

The following subsections present information on, or references to, reports with information on existing environmental, physical, social, economic, and policy and institutional conditions. This section is based primarily on existing and available information. Information on existing systemwide conditions will be updated as relevant technical data are developed for future updates of the CVFPP.

3.1.1 Existing Environmental Conditions

Three documents attached to the 2012 CVFPP were used to discuss the existing environmental conditions in the Systemwide Planning Area:

- The most detailed description of the ecological environment and biological conditions in the Systemwide Planning Area is in the PEIR (DWR, 2012). Topics discussed include aesthetics, air quality, aquatic and terrestrial biological resources, geology, soils, and seismicity, groundwater resources, hazards and hazardous materials, hydrology, land use and planning, noise, public services, recreation, transportation and traffic, utilities and service systems, and water quality.

- The RCR (DWR, 2010b) also discusses biological conditions (terrestrial and aquatic resources), social and economic conditions, cultural resources, institutional, emergency planning, response, and recovery.

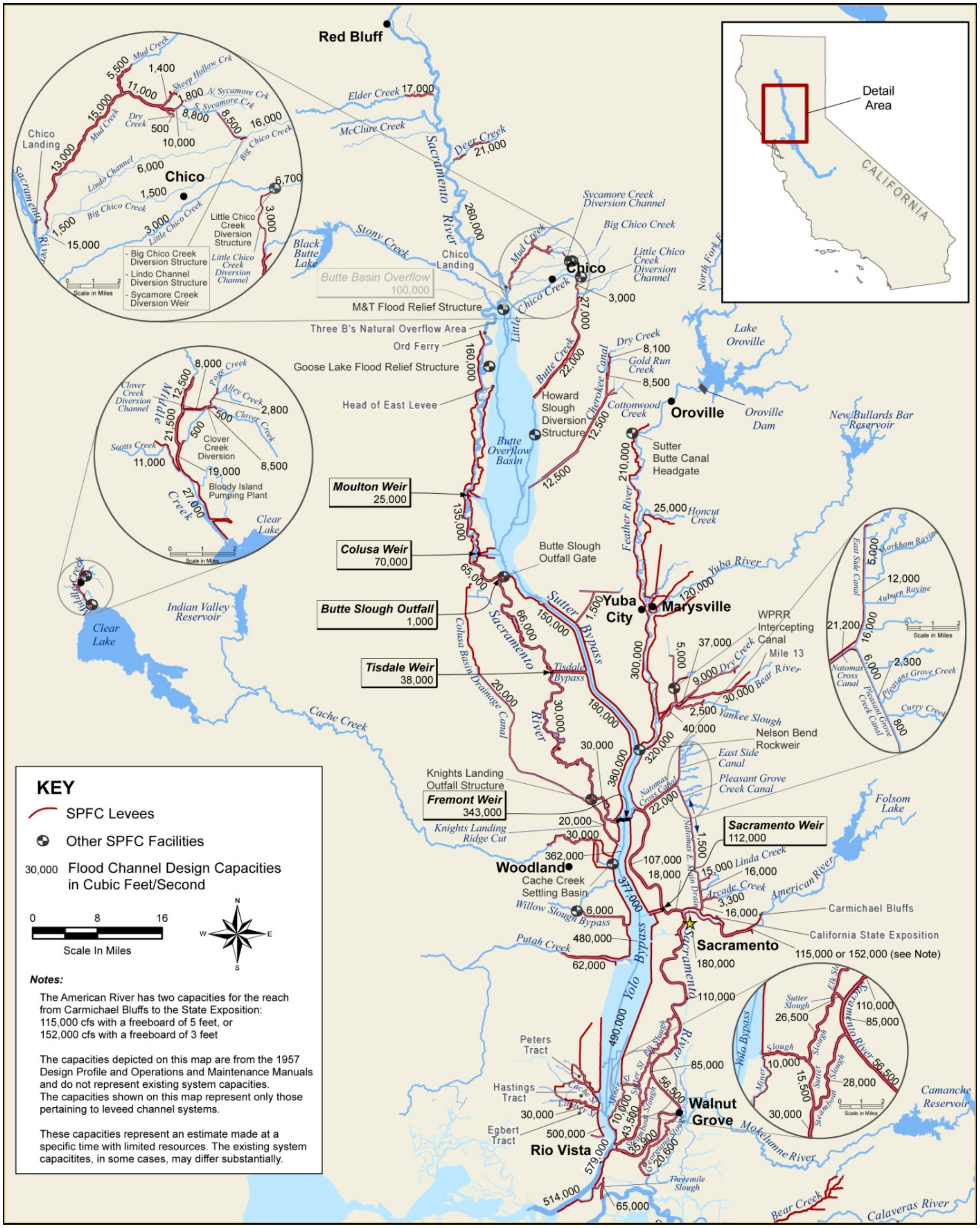
- Floodway ecosystem conditions are discussed in further detail in the Attachment 2: Conservation Framework. Topics discussed include river flow and hydrologic processes; geomorphic processes and channel and floodplain dynamics; and riparian and riverine habitats and species, invasive species, and fish passage barriers.

3.1.2 Existing Physical Conditions

The primary focus of the 2012 CVFPP is to reduce flood risk and promote integrated flood management for areas protected by the SPFC facilities illustrated in Figures 3-1 and 3-2, and described in Table 3-1.

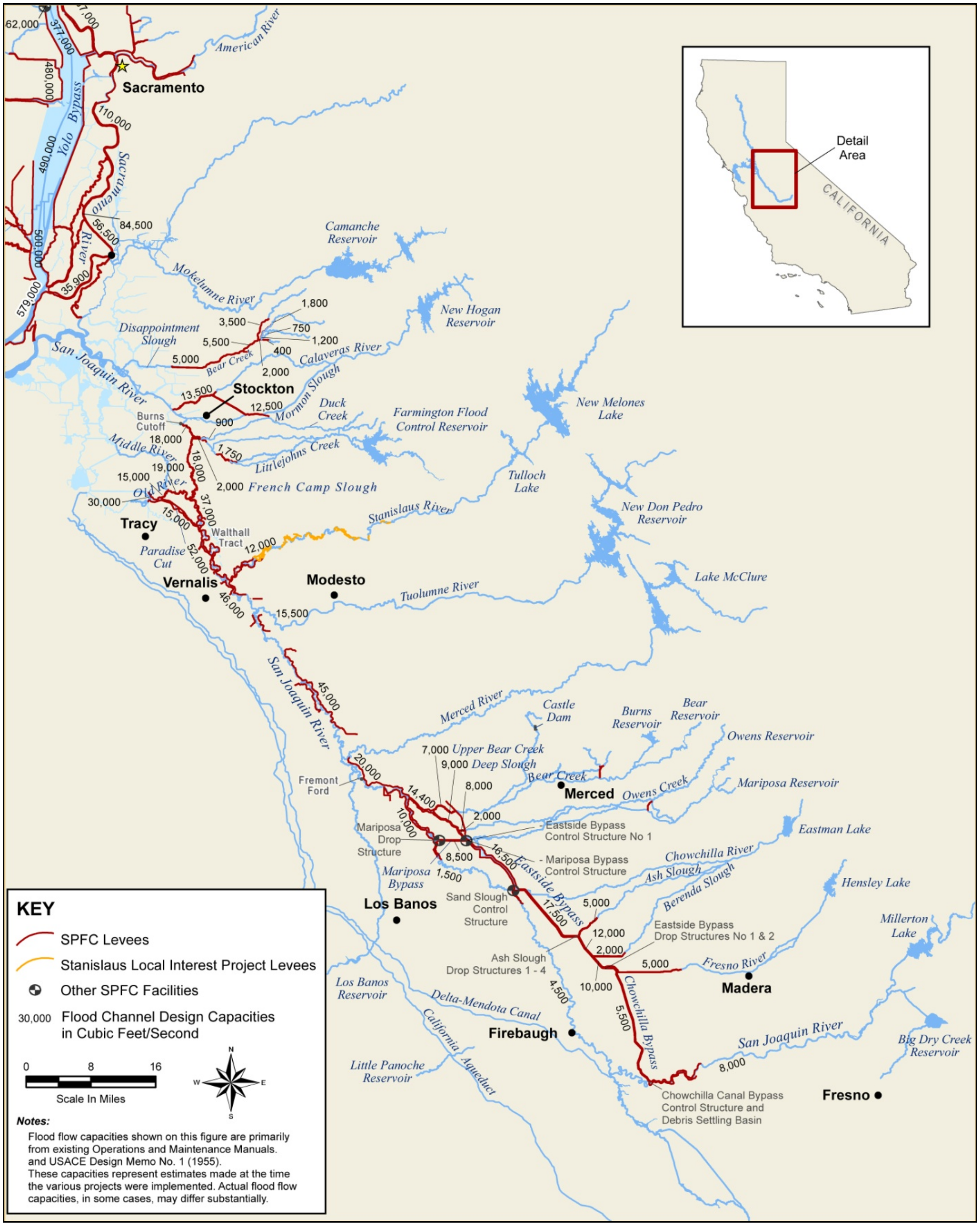
The SPFC flood management system evolved over time through an incremental construction process driven by periodic flood disasters, and the need to maintain navigable channels, reclaim lands for agricultural use, and support population growth and development in the Central Valley.

SPFC facilities have been added over time through the individual and combined efforts of State, federal, and local agencies. These features were constructed with varying design standards and construction techniques, and do not provide a consistent level of flood protection throughout the system. Despite efforts to manage floods through building and upgrading facilities, changes in land use in areas protected by the SPFC, including urban development in floodplains and a shift to higher value permanent agriculture, have increased consequences of flooding over time.



Key: SPFC = State Plan of Flood Control

Figure 3-1. State Plan of Flood Control Facilities, Sacramento River Basin



Key: SPFC = State Plan of Flood Control

Figure 3-2. State Plan of Flood Control Facilities, San Joaquin River Basin

Table 3-1. Overview of State Plan of Flood Control

Feature and Description
Project Works:
• Approximately 1,600 miles of levees • Two flood relief structures and one natural overflow area spilling floodwaters from the Sacramento River into the Butte Basin • Four fixed weirs (Moulton, Colusa, Tisdale, Fremont) and one operable weir (Sacramento) spilling floodwaters from the Sacramento River into the Butte Basin, Sutter Bypass, and Yolo Bypass • Four dams (North Fork Feather River Diversion, Oroville Dam, Cache Creek Settling Basin, Castle Dam) • Five control structures directing flow in bypass channels along the San Joaquin River • Seven major pumping plants • Channels • Bypasses and sediment basins • Environmental mitigation areas • Associated facilities, such as bank protection, stream gages, and drainage facilities
Lands:
• Fee title, easements, and land-use agreements • Approximately 18,000 parcels
Operations and Maintenance:
• Two standard operations and maintenance manuals • 118 unit-specific operations and maintenance manuals • Maintenance by State and local maintaining agencies
Conditions:
• Assurances of Cooperation (as specified in Memorandums of Agreement, the California Water Code, and agreements) • Flood Control Regulations, Section 208.10, 33 Code of Federal Regulations • Requirements of standard and unit-specific operations and maintenance manuals • Design profiles (e.g., 1955 and 1957)
Programs and Plans:
• Historical documents and processes • As-constructed drawings • Oversight and management • Ongoing programs and plans

Key:
State = State of California

Current Status of State Plan of Flood Control Facilities

Today, much of the legacy Central Valley flood management system is characterized by aging infrastructure, built over many years, often using outdated standards and techniques. In addition, the system is subject to different hydrologic and climate conditions at the present time than when the facilities were originally constructed. Society’s expectations for flood system performance that also supports other benefits, such as ecosystem function, are also different today than when the SPFC facilities were originally constructed.

Although the SPFC has prevented billions of dollars in flood damages since facilities were originally constructed, some SFPC facilities face a high chance for failure when evaluated against modern engineering and safety criteria (DWR, 2011). The general condition of urban levees, nonurban levees, and channels of the SPFC are presented in Figure 3-3 and summarized below:

- Approximately half of about 300 miles of SPFC urban levees evaluated do not meet current engineering criteria.

- Approximately three-fifths of about 1,200 miles of SPFC nonurban levees evaluated have a high relative potential for failure from under-seepage, through-levee seepage, structural instability, and/or erosion.

- Approximately half of the 1,016 miles of channels evaluated in the SPFC have inadequate capacities to convey design flows; these channels require additional evaluation to confirm conditions.

- None of the 32 hydraulic structures or 11 pumping plants inspected by DWR for the SPFC were rated Unacceptable during the 2009 inspections; however, many are approaching the end of their design lives and need replacement, or at least, major rehabilitation. Of the 10 SPFC bridges inspected by DWR in 2009, 2 were in need of repairs.

  The most detailed description of existing conditions for flood management facilities in the SPFC Planning Area are in the State Plan of Flood Control Descriptive Document (DWR, 2010a) and FCSSR (DWR, 2011a).

The SPFC represents a portion of the Central Valley flood management system for which the State has special responsibilities, as defined in the California Water Code. It is defined as follows (CPRC 5096.805(j)):

> *The state and federal flood control works, lands, programs, plans, conditions, and mode of maintenance and operations of the Sacramento River Flood Control Project described in Section 8350 of the Water Code, and of flood control projects in the Sacramento River and San Joaquin River watersheds authorized pursuant to Article 2 (commencing with Section 12648) of Chapter 2 of Part 6 of Division 6 of the Water Code for which the board or the department has provided the assurances of nonfederal cooperation to the United States.*

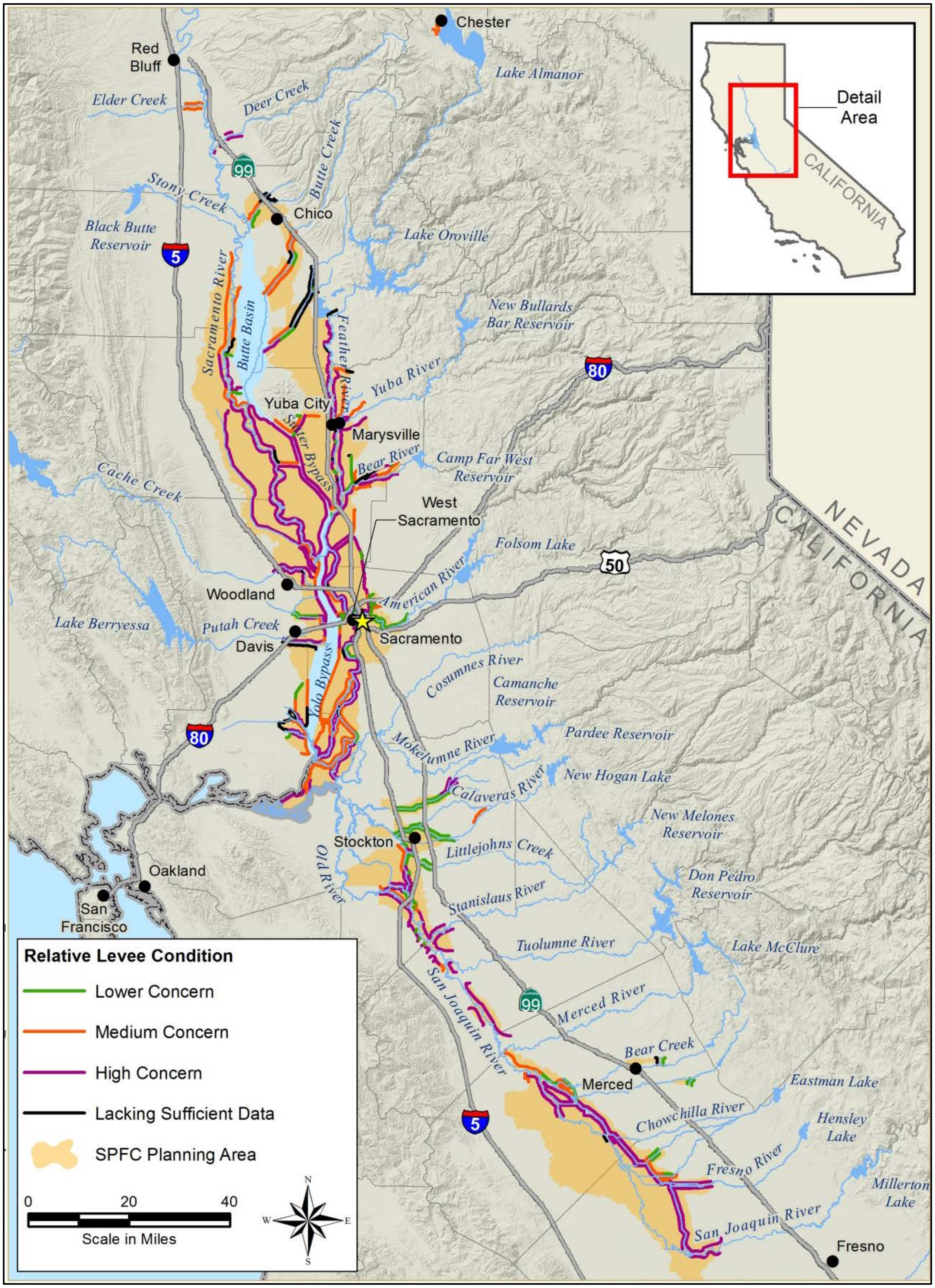


Figure 3-3. Summary of Physical Levee Conditions Based on Levee Evaluations Program Results

- The State Plan of Flood Control Descriptive Document (DWR, 2010a) includes detailed descriptions of SPFC works or facilities, SPFC lands, SPFC O&M, SPFC conditions, and programs and plans related to the SPFC. Existing physical conditions are described in Sections 2, 3, and 4. The document also includes a less detailed description of non-SPFC works or facilities that affect SPFC O&M as part of the larger flood management system.

- The FCSSR (DWR, 2011a) presents the current status, or physical condition of SPFC levees, channels, and flood control structures, and limited information on non-SPFC facilities. Adverse physical conditions identified in the FCSSR are used as a basis for defining flood and related resources problems for the 2012 CVFPP, and are discussed in Section 4.

3.1.3 Multipurpose Reservoirs and Designated Floodways

State Assurances of Cooperation to the Federal Government

- *Not given for most multipurpose reservoirs in the Central Valley because no direct State operational responsibility.*
- *Not given for designated floodways because they are a condition of project operation for the SPFC.*

There are numerous multipurpose reservoirs and designated floodways that are important to flood management in the Central Valley. The State has not provided assurances of cooperation to the federal government for most of the multipurpose dams (except Oroville Dam) or designated floodways, so they are not considered SPFC facilities.

Where implemented, the Board's Designated Floodway Program helps limit further development into active floodways. Although not considered SPFC facilities, designated floodways are an important management tool to help the State meet its requirement for passing project design flows and are therefore a condition of project operation for the SPFC. For more information on how designated floodways are part of the SPFC, see Section 6.8 of the State Plan of Flood Control Descriptive Document (DWR, 2010a).

Figure 3-4 provides an overview of multipurpose reservoirs within the Sacramento and San Joaquin river basins that include flood management as one of the purposes. Additional details concerning the reservoirs are summarized in Table 3-2. An overview of designated floodway locations is shown in Figure 3-5.

3.1.4 Assets Protected by the State Plan of Flood Control

Over the last century, the Central Valley has experienced intensive development to meet the needs of a growing population. A complex water supply and flood risk management system supports and protects a vibrant agricultural economy, several cities, and numerous small communities. The SPFC protects a population of more than 1 million people, major freeways, railroads, airports, water supply systems, utilities, and other infrastructure of statewide importance, including more than $70 billion in assets (includes structural and content value, and estimated annual crop production values) (Figure 3-6). Many of the more than 500 species of native plants and wildlife found in the Central Valley rely to some extent on habitat existing within the SPFC Planning Area.

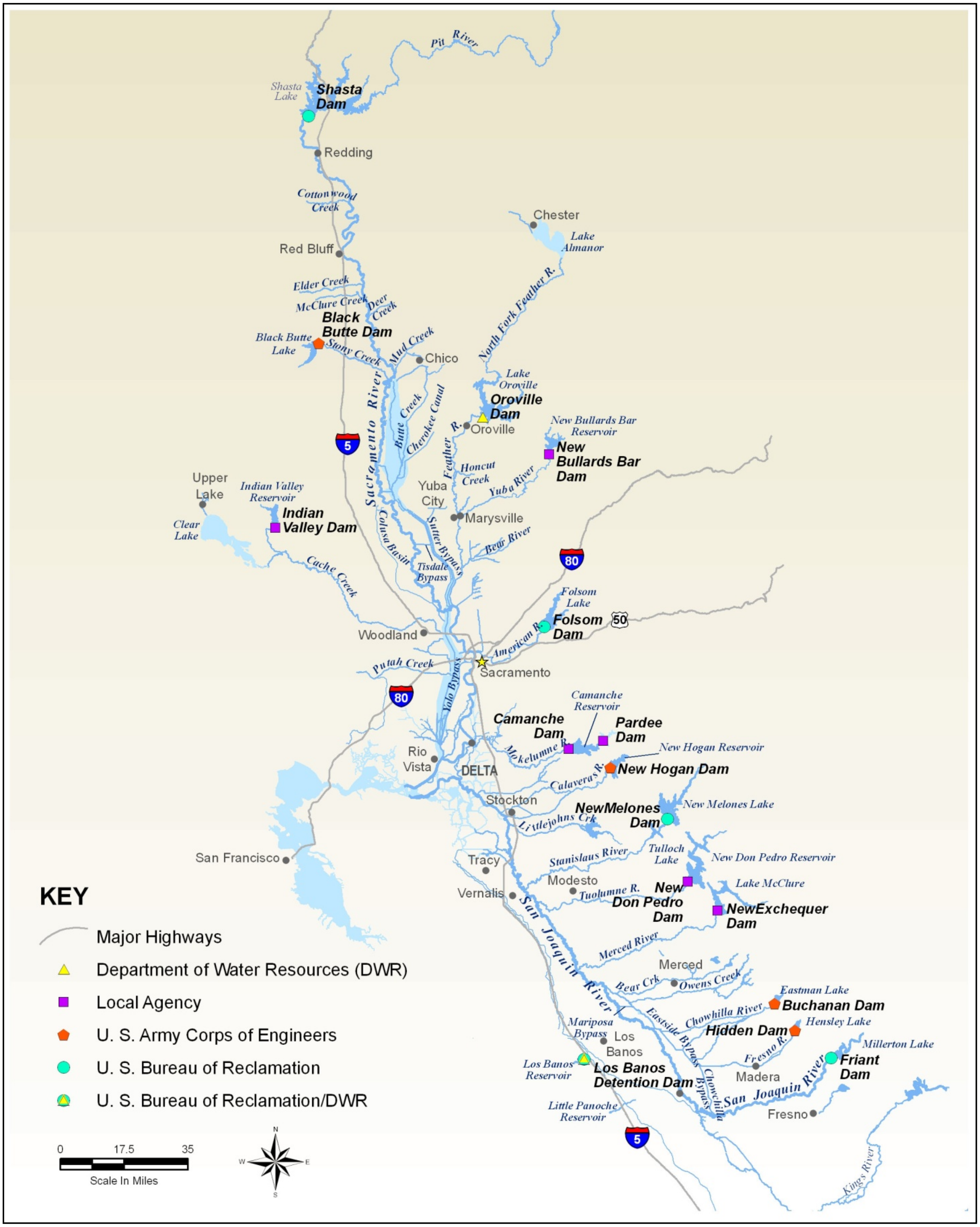


Figure 3-4. Multipurpose Reservoirs Within Sacramento and San Joaquin River Basins

Table 3-2. Multipurpose Reservoir Project Summary

Reservoir	Dam	Year Completed	Total Reservoir Capacity (TAF)	Flood Storage Capacity (TAF)	Owner/Operator
Sacramento River Basin					
Shasta Lake	Shasta Dam	1949	4,552	1,300	Reclamation
Black Butte Lake	Black Butte Dam	1963	144	136	USACE
Folsom Lake	Folsom Dam	1956	975	670[2]	Reclamation
Lake Oroville	Oroville Dam[1]	1967	3,538	750	DWR
New Bullards Bar Reservoir	New Bullards Bar Dam	1967	970	170	Yuba County Water Agency
Indian Valley Reservoir	Indian Valley Dam	1976	301	40	Yolo County Flood Control and Water Conservation District
San Joaquin River Basin					
Millerton Lake	Friant Dam	1949	521	170[3]	Reclamation
Lake McClure	New Exchequer Dam	1967	1,025	350	Merced Irrigation District
New Don Pedro Reservoir	New Don Pedro Dam	1970	2,030	340	Turlock Irrigation District
Hensley Lake	Hidden Dam	1975	90	65	USACE
H.V. Eastman Lake	Buchanan Dam	1975	151	45	USACE
New Melones Lake	New Melones Dam	1978	2,420	450	Reclamation
Los Banos Detention Reservoir	Los Banos Dam	1965	35	14	Reclamation/DWR
Pardee Reservoir	Pardee Dam	1963	210	200[4]	East Bay Municipal Utilities District
Camanche Reservoir	Camanche Dam	1963	431		
New Hogan Reservoir	New Hogan Dam	1964	317	152	USACE

Source: USACE, 1997

Notes:

[1] Oroville Dam is part of the SPFC, as is the smaller single-purpose Castle Dam in the San Joaquin River Basin. All other dams in this table are non-SPFC.

[2] Folsom Dam is operated with variable flood storage between 400,000 acre-feet and 670,000 acre-feet to take credit for seasonally available storage in upstream reservoirs.

[3] Friant Dam is operated in conjunction with Mammoth Pool and upstream reservoirs.

[4] Camanche Dam is operated in conjunction with Pardee Dam and upstream reservoirs.

Key:

DWR = California Department of Water Resources

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

SPFC = State Plan of Flood Control

TAF = Thousand acre-feet

USACE = U.S. Army Corps of Engineers

Figure 3-5. Designated Floodways Within Sacramento and San Joaquin River Basins

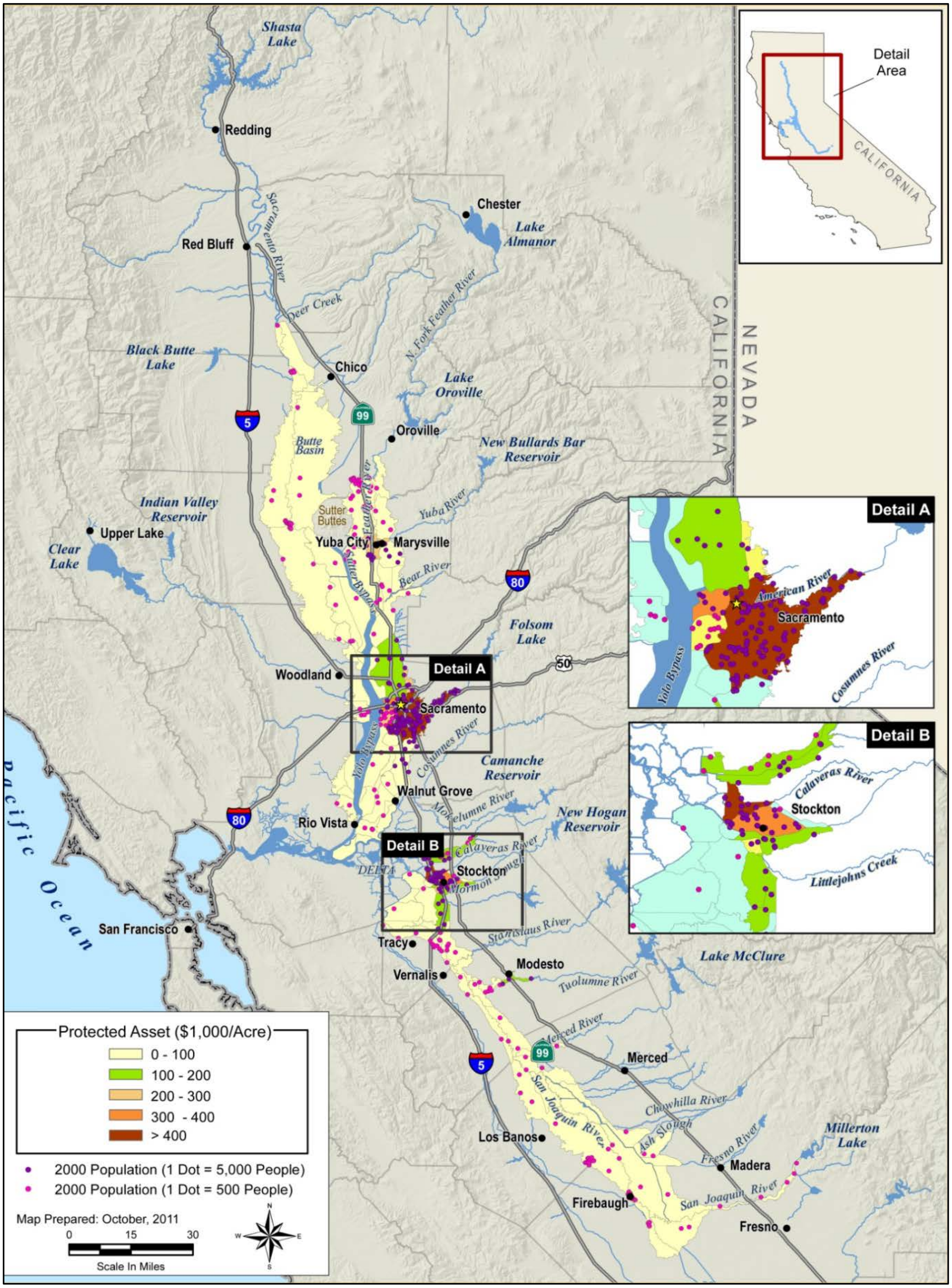


Figure 3-6. Geographic Distribution of Assets Protected by State Plan of Flood Control Facilities

3.1.5 Existing Social and Economic Conditions

Detailed descriptions of existing social and economic conditions in the planning area are summarized in the Attachment 8: Technical Analysis Summary Report:

- **Attachment 8F: Flood Damage Analysis –** Expected annual damages are calculated using the USACE Hydraulic Engineering Center (HEC)-Flood Damage Assessment (FDA) model to analyze direct tangible flood damages to structures, businesses, and crops, and indirect tangible costs related to emergency response and recovery.

- **Attachment 8G: Life Risk Analysis –** Analyzes life risk as a qualitative indicator of flood risk using a HEC-FDA modeling approach.

- **Attachment 8H: Regional Economic Analysis –** Estimates the effects of proposed flood management improvements on regional economic activity, specifically employment (jobs) and output (dollars).

- **Attachment 8I: Benefit Assessment –** Describes benefit categories associated with proposed flood management improvements in the 2012 CVFPP.

Topics in the attachments include building cost per square foot; estimate of structure and content value, crop damage values; estimate of emergency costs; life safety as an indicator of flood risk; comparison of conditions analyzed and their respective life safety values; population and household income; employment and economic output by industry, employment, State and local tax revenue; regional economic impact analysis; and economic benefit evaluation framework.

3.1.6 Existing Policy and Institutional Conditions

Detailed descriptions of policy and institutional conditions in the Systemwide Planning Area are presented in the RCR (DWR, 2010b). Topics include laws and regulations, governance structures and responsibilities, funding, and coordination. Further description of existing policy and institutional conditions are contained in the Descriptive Document, Sections 5, 6, and 7, for O&M, conditions (terms), and programs and plans related to the SPFC.

3.2 Likely Future Systemwide Conditions

Defining existing conditions and how these conditions may change in the future is critical to the planning process. The magnitude of change influences not only the scope of problems and opportunities, but the extent of related conditions that could be affected by possible actions taken to address them. This section briefly describes the period of analysis for the 2012 CVFPP, key drivers and influencers for integrated flood management, and likely future conditions.

For the 2012 CVFPP, the period of analysis is through 2050. The period of analysis is the time frame for which plan effects are evaluated and likely changes in conditions are considered. All plan elements were analyzed using this period of analysis. It should be noted that project life for many plan elements may be longer than the period of analysis. Further, it may not be possible to project or anticipate all changes over the period of analysis.

Key drivers and influencing factors associated with integrated flood management define likely future conditions and challenges. Drivers are trends and external forces outside the control of flood managers that impact integrated flood management. Drivers and influencers for integrated flood management in the Central Valley include the following:

- Change in population, and type and location of development in floodplains
- Water supply reliability and conveyance needs
- Climate change
- Environmental regulations
- Water quality
- Availability of public funding for flood management system improvements
- Legislative mandates to increase levels of flood protection in urban and urbanizing areas

For more detailed information on these drivers and influencers, see the RCR (DWR, 2010b).

Predicting future changes to the physical, biological, social, and economic environments is complicated by various flood management, ecosystem restoration, water supply reliability, and water quality efforts that are anticipated to be implemented over the period of analysis (through 2050). It is difficult to estimate how these individual projects may influence future conditions because they are not part of a well-defined, integrated, or regional plan. Furthermore, these efforts may not meet the conditions generally required for projects to be considered reasonably foreseeable (i.e., authorized, funded, and permitted, or under construction). Following is a brief description of likely changes in future conditions.

3.2.1 Likely Future Environmental Conditions

Basic conditions in the physical environment are expected to remain relatively unchanged in the future. No significant changes to area topography, bathymetry, soils, or geology are foreseen. Continued development in urban and suburban areas is expected.

Without physical changes to the river basins, hydrologic conditions will probably also remain unchanged. The region's hydrology could be altered should there be significant changes in global climatic conditions. Without changes in hydrology, topography, or geology, sedimentation and erosion patterns are also likely to remain unchanged.

Increased population is one factor that could degrade water quality, but existing regulations require mitigation for that effect. Increased ecosystem restoration (i.e., restored wetlands) would provide some improvement in water quality. In addition, efforts are underway to better manage the quality of runoff from urban environments to stream systems, and to control the levels and types of herbicides, fungicides, and pesticides that can be used in the environment.

As the population continues to grow, a general degradation of air quality conditions could occur. However, because of technological innovation and increasingly stringent regulations, air quality could improve over time.

Ongoing restoration efforts along rivers are expected to marginally improve natural riparian habitat, riverine processes, and rivers' abilities to meander. Restoring floodplain processes will also provide some flood protection by increasing groundwater recharge. Without levee realignments or new offstream storage or bypasses, the geomorphology of the Sacramento and San Joaquin river basins would remain similar to present conditions.

Efforts are underway by numerous agencies and groups to restore various biological conditions throughout the Sacramento and San Joaquin river basins. Accordingly, areas of wildlife habitat, including wetlands and riparian vegetation areas, are expected to be protected and restored. While regional habitat planning initiatives exist, most habitat improvement will be based on separate opportunities that are not integrated in a single plan. Therefore, ongoing restoration will likely provide localized benefits.

Through ongoing efforts of various agencies and groups, populations of special-status species in riverine and nearby areas are estimated to generally remain constant. Although increases in anadromous and resident fish populations could occur through implementing various ongoing restoration projects, some degradation will likely occur through actions that reduce flows or elevate water temperatures.

3.2.2 Likely Future Physical Conditions

Urban development within floodplains will increase the need for improved flood management. Urban development adjacent to existing flood management facilities will limit options and opportunities for facilities improvement in urban areas. The cost and time necessary to conduct routine facility maintenance or reconstruct or improve existing facilities will affect implementation of those efforts. Compliance with existing environmental regulations will continue to constrain maintenance activities and affect decisions on where and when new flood management facilities can be constructed, pending funding availability.

3.2.3 Likely Future Social and Economic Conditions

The population of California is estimated to increase from about 37 million to more than 60 million by 2050 (DOF, 2007). Growth in population may contribute to the conversion of agricultural and other rural land to urban uses, particularly in the Central Valley. This will increase flood risk and further reduce land available for maintaining and restoring ecosystem values.

Anticipated increases in population growth in the Central Valley will also increase demands on water resources systems for additional and reliable water and energy supplies; water-related, recreational, and flood management facilities; water and wastewater utilities; public services such as fire, police protection, and emergency services; and communication infrastructure. Modification of existing traffic corridors and construction of new transportation routes will likely occur, further connecting anticipated population growth centers in the Central Valley. Anticipated increases in population will also have impacts on visual resources as areas of open space are converted to urban uses.

3.2.4 Likely Future Policy and Institutional Conditions

Flood management in the Central Valley rests on a complex institutional landscape. Laws and regulations exist at multiple levels (State, federal, and local), and are evolving. Changing laws and regulations will need to be considered for future plans and projects.

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4.0 Flood and Related Resource Problems

As discussed in the Regional Conditions Report – A Working Document (DWR, 2010b), the landscape of the Central Valley and its drainage area has changed dramatically since the flood management system was initially built because of urban expansion, agricultural intensification, changes in societal values, and changes in land cover in the valley and upper watershed source areas. From these and other changes, problems have developed related to flood risk management and related resource conditions. This section describes flood-management-related problems that are addressed through the 2012 CVFPP.

In the context of this section, a "problem" is an undesirable condition – something that is currently viewed as "broken" or will likely be so in the future. Problems provide a common focal point or reason for people to join together in a planning process. As part of the outreach process for the 2012 CVFPP, problems were initially identified from the input of State, federal, regional, local, and tribal interests. Many of these interested parties participated in planning area work groups and/or topic work groups convened to help articulate existing resource conditions for the 2012 CVFPP; problem identification was an important output of those meetings. In this manner, the outreach process helped DWR identify potential environmental, physical, economic and demographic, and policy and institutional problems. Concurrently with the outreach process, environmental problems were clarified through the CVFPP PEIR, and physical problems were clarified through the FCSSR.

As mentioned, problems are the common ground that motivates collective participation in a planning process – the reason for undertaking the effort. As such, problems were instrumental in helping participants shape broad goals and specific objectives for the 2012 CVFPP, and were crucial building blocks for identifying, developing, and screening potential management actions and solutions. These initial solutions and management actions were captured and advanced for consideration in the next phase in the 2012 CVFPP development process, which is preliminary approach development.

4.1 Environmental Problems

> **Identified Flood Risks & Related Problems**
>
> **Ecosystems** – The construction, operations, and maintenance of the existing flood management system have also contributed to declining conditions and trends for biological resources within the flood management system. This includes the loss, degradation, and fragmentation of natural aquatic and terrestrial habitat; declines in species populations and constraints on species movement; increases in stressors on these habitats and species; and disruption in the hydrologic, geomorphic, and ecological processes upon which their habitats and species depend.

This section briefly describes environmental problems in the Systemwide Planning Area. For more detail, see the PEIR and Attachment 9B: Status and Trends of the Riparian and Riverine Ecosystems of the Systemwide Planning Area.

Much of the Central Valley levee system was built over many years using whatever sands, silts, clays, and soils, including organic soils that were conveniently available, often poorly compacted over inadequate foundations. Due to limited data, estimates of storm magnitudes, and, thus, flood storage and conveyance requirements, have been consistently low. System capacity issues are further exacerbated by the impacts (such as increased variability) of global climate change. This evolving system of levees, bypasses, dams, and pumps was originally constructed to foster economic development and promote public safety. However, with declining environmental quality due to many causes, the remaining high-quality riparian habitat along the Central Valley's leveed streams has taken on greater importance for the preservation of salmon (*Oncorhynchus*), steelhead (*Oncorhynchus mykiss*), sturgeon (*Acipenser*), Swainson's hawks (*Buteo swainsoni*), bank swallows (*Riparia riparia*), giant garter snakes (*Thamnophis gigas*), and many other threatened or endangered species. Environmental quality has become an increasingly important consideration in the design, construction, operations, and maintenance of the flood management system.

In many parts of the Sacramento and San Joaquin river basins, dynamic, geomorphic and biological processes are severely compromised. The historical practice of constructing SPFC levees close to the river channels to induce sediment scour has, in many cases, interfered with the natural stream meandering process. Riverine habitats and ecosystem functions have been degraded over time through changes in land use, construction of dams and levees, water pollution, and other causes.

As a result, the geographic extent, quality, and connectivity of native habitats along Central Valley rivers have all declined so that the system can no longer support sustainable populations of many species. Today, less than 4 percent of the historical riparian forests that lined valley streams remain, with a significant portion of this forest growing on, or close to, levees of the SPFC.

4.2 Physical Problems

Physical problems affecting performance of SPFC facilities are described in detail in the FCSSR (DWR, 2011a). Although the SPFC has prevented billions of dollars in flood damages since construction, some SFPC facilities face an unacceptably high chance of failure. In addition, an unintended consequence of the long-term effort to construct and upgrade SPFC facilities and the multipurpose reservoir system is that flood damages have increased over time due to development in levee-protected areas. That is, although the chance and frequency of flooding are decreased, the damages that occur when flooding does occur are much greater, resulting in a net long-term increase in cumulative damages.

The overall condition of urban levees, nonurban levees, channels, and flood control structures of the SPFC are presented in Figure 4-1 and can be summarized as follows:

- **Urban levees –** Approximately half of about 300 miles[8] of SPFC urban levees evaluated do not meet current levee freeboard, stability, or seepage design criteria[9] at the design water surface elevation.

- **Nonurban levees –** Approximately three-fifths of about 1,200 miles of SPFC nonurban levees evaluated have a high potential for failure from under-seepage, through-seepage, structural instability, and/or erosion at the assessment water surface elevation.[10] Nonurban levees were evaluated based on systematic, consistent, repeatable analyses that correlated geotechnical data with levee performance history, not relative to any current design criteria.[11]

- **SPFC channels –** Approximately half of the 1,016 miles of channels evaluated in the SPFC have a potentially inadequate capacity to convey design flows, and require additional evaluation to confirm conditions.

Identified Flood Risks & Related Problems

Operations & Maintenance – O&M (including significant repairs) of the flood management systems in the Sacramento and San Joaquin river basins is difficult and often deferred because of limitations from original system design; prevalent system encroachments; inconsistent standards and practices; complex, time-consuming, and at times conflicting permitting and mitigation requirements, and lack of reliable funding sources and financial instruments.

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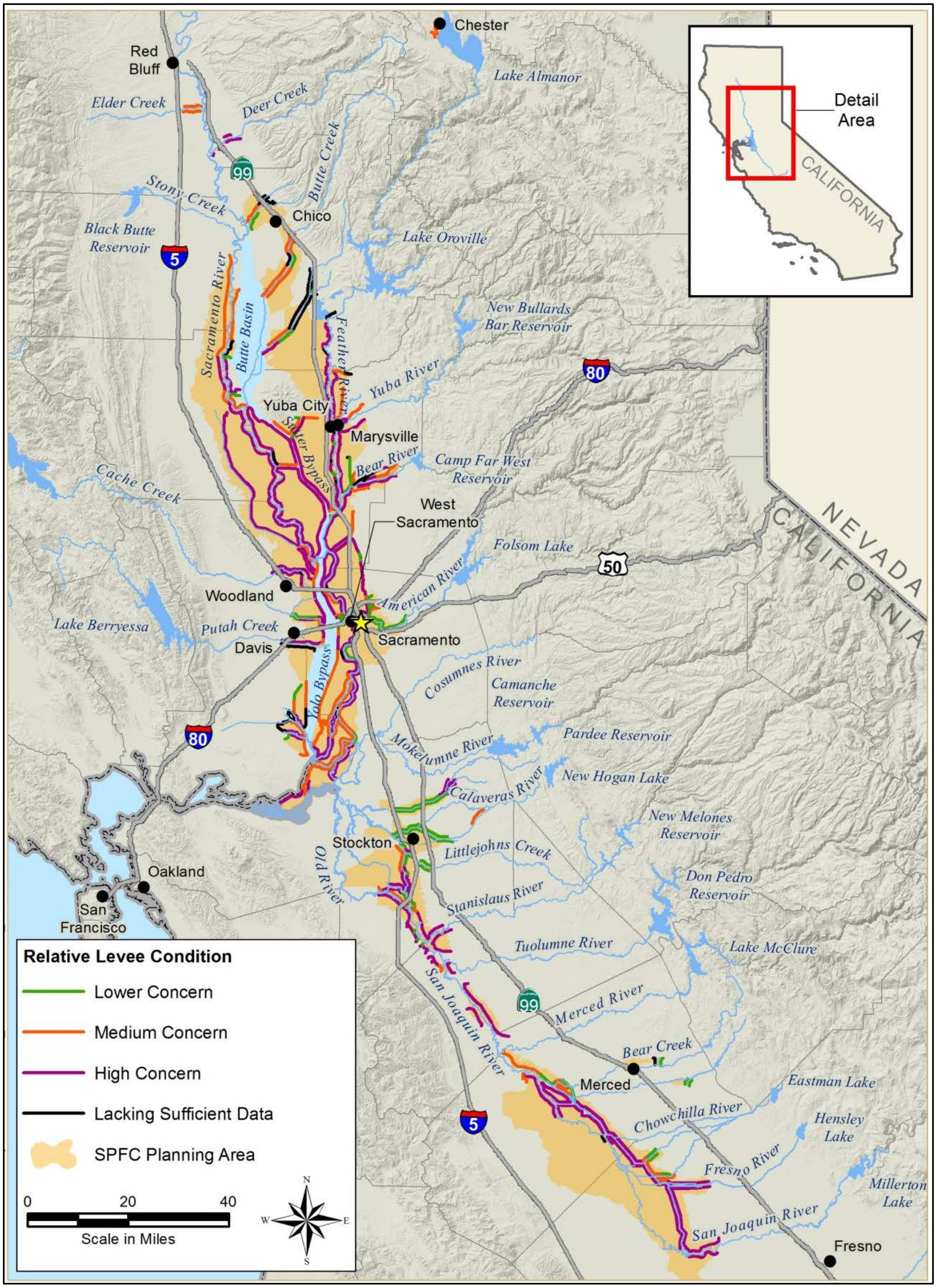
8 Additional 10 miles of SPFC urban levees are being evaluated, and results will be included in future updates.

9 The design criteria used were based on the USACE 2000 *Design and Construction of Levees Engineering Manual 1110-2-1913,* and DWR 2010 *Interim Levee Design Criteria for Urban and Urbanizing Areas in the Sacramento Valley, Version 4*.

10 Where available, 1955/57 design water surface elevations were used as the assessment water surface elevation. In the absence of 1955/57 design water surface elevations, the assessment water surface elevation was based on freeboard requirements for each levee segment (i.e., generally 3 feet below the levee crest).

11 This approach was selected because the extent of the NULE Project is significantly greater than the ULE Project, making it difficult to conduct the same level of field explorations and geotechnical data collection performed for ULE levees.



Key: SPFC = State Plan of Flood Control

Figure 4-1. Summary of Physical Levee Conditions Based on Levee Evaluations Program Results

- **SPFC flood control structures –** None of the 32 hydraulic structures or 11 pumping plants inspected by DWR for the SPFC were rated Unacceptable during the 2009 inspections. Of the 10 SPFC bridges inspected by DWR in 2009, 2 were in need of repairs.

O&M and repairs of the flood management system are difficult to execute and often deferred for many reasons. These include the original system design deficiencies; inadequate funding; encroachments; inconsistent levee maintenance practices among maintaining agencies; and complex, time-consuming, and conflicting permitting and mitigation requirements.

Table 4-1 lists factors that influence facility performance, findings related to each factor, and the relative threat posed by the factor.

Table 4-1. Flood Control System Status Report Findings

	Factors	Findings	Relative Threat Posed by Factor[1]
Levees	**Overall Levee Condition (multiple factors)**	• Approximately half of SPFC urban levees do not meet current levee freeboard, stability, or seepage design criteria at the design water surface elevation. • Approximately three-fifths of SPFC nonurban levees have a high potential for levee failure from under-seepage, through-seepage, structural instability, and/or erosion at the assessment water surface elevation.	See Figure ES-2
	Levee Geometry Check	• Approximately one-third of SPFC urban levees deviate from current standard levee design prism criteria. • Levee geometry deviates significantly from the standard levee design prism criteria for some nonurban SPFC levees.	Medium
	Seepage	• Approximately one-third of urban levees do not meet current seepage design criteria. • Almost half of SPFC nonurban levees have a high potential for levee failure from under-seepage. • Approximately one-quarter of SPFC nonurban levees have a high potential for levee failure from through-seepage.	High
	Structural Instability	• Approximately one-fifth of SPFC urban levees do not meet current structural stability design criteria. • Approximately one-seventh of SPFC nonurban levees evaluated in the Sacramento River watershed and 1 percent in the San Joaquin River watershed have a high potential for levee failure from structural instability.	Medium
	Erosion	• Erosion assessments for urban levees are underway, and results are not available at this time. • Almost one-sixth of SPFC nonurban levees have a high potential for levee failure from erosion.	Medium
	Settlement	• Four known localized levee locations have settlement (localized depressions) that endangers the integrity of SPFC levees.	Low
	Penetrations[2]	• More than 6,000 penetration sites are documented in SPFC levees, and many more remain undocumented.	Medium

Table 4-1. Flood Control System Status Report Findings (contd.)

	Factors	Findings	Relative Threat Posed by Factor[1]
Levees (contd.)	Levee Vegetation	• About 15 miles of SPFC levees are noncompliant with DWR 2007 Interim Levee Vegetation Criteria.3 5	Low
	Rodent Damage	• More than one-third of the 1,459 miles of SPFC levees studied had at least eight reported occurrences of burrowing activity over a 21-year study span.	Medium
	Encroachments[4]	• 1,223 encroachment sites were identified as partially or completely obstructing visibility and access to the levee and/or within 10 feet of the landside toe.5	Medium
Channels	Inadequate Conveyance Capacity	• Approximately half of the 1,016 miles of SPFC channels evaluated are potentially inadequate to convey design flows, and require additional evaluation to confirm conditions. • Approximately one-quarter of channel design capacities reported in O&M manuals do not agree with flows specified in the design profiles.	Medium
	Channel Vegetation	• Of 186 miles of SPFC channels inspected by DWR, one location was rated Unacceptable and 54 locations were rated Minimally Acceptable because of vegetation and obstructions.5	Low
Structures	Channel Sedimentation	• Of 186 miles of SPFC channels inspected by DWR, 1 location was rated Unacceptable and 23 locations were rated Minimally Acceptable because of shoaling/sedimentation.5	Low
	Inadequate Hydraulic Structures	• Of 32 SPFC hydraulic structures inspected by DWR, no structures were rated Unacceptable because of structural, vegetation/obstruction, encroachment, or erosion/sedimentation	Low
	Inadequate Pumping Plants	• Of 11 SPFC pumping plants inspected by DWR, none were rated Unacceptable.5	Low
	Inadequate Bridges	• Of 10 SPFC bridges inspected by DWR, 2 were in need of repairs.5	Low

Notes:

[1] The relative threats listed in Table 4-1 were generated based on professional experience of technical staff from DWR and partner agencies.

[2] Penetrations include man-made objects that cross through or under a levee or floodwall and have the potential to provide a preferential seepage path or hydraulic connection with the waterside. Typically, a penetration is a pipe or transportation structure, such as a roadway or rail line.

[3] This finding is based on DWR 2007 *Interim Levee Vegetation Criteria* and not on USACE levee vegetation criteria. Comparison with USACE levee vegetation criteria would show more SPFC levees as noncompliant.

[4] Encroachments are any obstruction or physical intrusion by construction of works or devices, planting or removal of vegetation, or caused by any other means, for any purpose, into a flood control project, waterway area of the flood control project, or area covered by an adopted plan of flood control (California Code of Regulations Title 23 Chapter 1 Article 2 Section 4 (m)). Encroachments include boat docks, ramps, bridges, sand and gravel mining, placement of fill, fences, retaining walls, pump stations, residential structures, and irrigation and landscaping materials/facilities.

[5] Inspection results reported are from DWR's 2009 Inspections.

Key:
DWR = California Department of Water Resources
O&M = operations and maintenance
SPFC = State Plan of Flood Control
USACE = U.S. Army Corps of Engineers

The findings in Table 4-1 are relative to DWR's current criteria for use in the 2012 CVFPP. In most cases, these criteria are identical, or very similar to, USACE criteria. However, differences between DWR and USACE levee vegetation criteria are significant enough that comparison of levees with USACE criteria would likely show more SPFC levees as noncompliant with current USACE criteria. Accordingly, using USACE criteria for vegetation on levees would likely result in a finding of more SPFC levees receiving lower inspection ratings than presented in the FCSSR. DWR and USACE continue to work to resolve these differences.

4.3 Social and Economic Problems

As discussed in previous sections, the Sacramento and San Joaquin river basins have been subject to flooding and increased flood risk to people and property because of physical and operational constraints of the existing flood management system, increasing use of facilities for multiple purposes beyond the original intent of the system, and changing land uses and increased population in flood-prone areas stemming from limited understanding of flood risk.

Population increase and distribution will likely drive changes in land-use patterns, potentially increasing the population at risk from flooding and possibly further reducing existing agricultural land and wildlife habitat. Continued urban development within major floodplains will also make future changes to the footprint of the flood management system progressively more costly, and increase consequences and risks (life safety and damages) when the flood management system is overwhelmed.

Climate change is expected to generate more extreme floods, a greater fraction of seasonal precipitation as rain rather than snow, and rising sea levels. These trends appear to be already well established and, if they continue as expected, they will put increasing stress on California's flood management system. Floodplain risk assessments and development constraints will likely be adjusted accordingly. For example, the 1 percent and 0.5 percent annual chance flood events, calculated based on historical flood events, will become larger for many watersheds, with long-term effects on National Flood Insurance Program map ratings, flood insurance costs, floodplain development, and the economic viability of floodplain communities. In addition, as the moderating effects of snowpack on runoff decrease, there will be a need for both greater flood control storage and water supply storage, putting greater pressure on California's multipurpose

Identified Flood Risks & Related Problems

Risks & Consequences of Flooding– The Sacramento and San Joaquin River basins have been subject to flooding and increased flood risk to people and property due to physical and operational constraints of the existing flood management systems, increasing use of facilities for multiple purposes beyond the original intent, and changing land uses in flood-prone areas stemming from limited understanding of flood risk. Flood risk is likely to continue to increase in some areas of the river basins because of climate change.

flood control reservoirs. Increased temperatures and altered runoff patterns also directly impact the health of California's natural ecosystems and habitats.

Although flooding along the Sacramento and San Joaquin rivers and their major tributaries is a natural process, flooding poses significant risks to human life, health, and safety. Social and economic problems are defined in the 2012 CVFPP Supporting Documentation, Technical Documentation, Attachment 8F: Flood Damage Analysis, Attachment 8G: Life Risk Analysis, and Attachment 8H: Regional Economic Analysis.

4.4 Policy and Institutional Problems

Identified Flood Risks & Related Problems

Policy & Institutional – Responsibilities and roles for flood management in the Sacramento and San Joaquin river basins are dispersed among many agencies with varying functions and priorities.

Responsibilities for flood management and land-use decisions in the Sacramento-San Joaquin Valley are dispersed among many agencies. The development, maintenance, and improvement of the State's flood management system, as well as land-use planning, are all related. Land-use decisions, such as those involving development in floodplains, are typically made at the local level by counties and cities. Local jurisdictions often have economic incentives to support and encourage such development. On the other hand, when levees fail, resulting in flood damages and loss of life, the costs associated with floodfighting, rescue, recovery, and rehabilitation are shared by local, State, and federal agencies.

Dispersal of these responsibilities across many local, regional, State, and federal agencies can lead to policies, funding practices and mechanisms, and institutional arrangements that do not support effective flood management and land-use planning.

Overlapping jurisdictions across various federal and State agencies involved in flood management can lead to inconsistent policies and regulations. Coordinating activities within this fragmented jurisdictional landscape can be challenging, particularly for local entities.

Policy and institutional problems were identified through the outreach process and through the SPFC Descriptive Document (Section 6) (DWR, 2010a). Contributing factors related to policy and institutional problems and their relevance to each of the 5 planning regions discussed in Section 2 can be summarizes as follows:

- Flood management is often made difficult by large number of agencies and entities involved because of the following for all regions:

  - Complex jurisdictional roles and responsibilities
  - Conflicting policies, missions, and priorities
  - Conflicting regulations and legislation
  - Lack of coordination (planning and implementation)
- Land-use decisions at local level may not adequately consider flood risk because of the following:
  - Poor or outdated flood risk information and maps for all regions
  - Strong desire for economic development for parts of all regions
- Land-use practices can affect flood management because of the following for parts of all regions:
  - Rapid urbanization
  - Agricultural land practices
- There is a trend toward strict liability for damages due to flood control facility failure that deters construction and effective management of flood management projects for all regions
- Current State, federal, and local funding mechanisms are not adequate to sustain effective flood management because of the following for all regions:
  - Inability to assess and generate funding at a local level
  - Limitations on State funding
  - Declining federal cost share
  - Federal benefit/cost requirements

Note that the list above is subjective based on the 2012 CVFPP outreach process, and are not meant to be scientifically precise or imply that technical or scientific documentation about the condition is necessarily available. In some instances, although problems listed above may have been previously been experienced in some regions and have since been resolved, concerns remain over the problem potentially recurring in the future.

Identified Flood Risks & Related Problems

Integrated Water Management – The flood management systems within the Sacramento and San Joaquin river basins rely on physical hydrologic features, infrastructure, and institutional arrangements that affect other components of water resources management. Flood management requirements often make it difficult to meet other water resource needs.

4.5 Integrated Water Management

The flood management systems within the Sacramento and San Joaquin river basins rely on physical hydrologic features, infrastructure, and institutional arrangements that affect other components of water resources management. Flood management requirements often make it difficult to meet other water resources needs. DWR is currently promoting the concept of integrated regional water management (IRWM). IRWM planning is the way in which DWR hopes to achieve sustainable water uses, reliable water supplies, better water quality, environmental stewardship, efficient urban development, protection of agriculture, a strong economy, and improved flood management. Based on the 2012 CVFPP outreach process, IRWM is being made difficult by competing needs for flood protection, water supply, ecosystem resources, recreation, water quality, hydropower, and dam safety in all regions.

5.0 Goals, Principles, and Objectives

The goals, principles, and objectives of the 2012 CVFPP provide direction, guidance, and focus for how the 2012 CVFPP will be developed over time. The goals, principles, and objectives are described below.

5.1 Goals

In the planning process, goals describe broad and enduring values, direction, or desired conditions to be achieved, without prescribing or suggesting specific actions to achieve the goals. As part of the FloodSAFE Initiative, development of the 2012 CVFPP is guided by overarching FloodSAFE goals and goals specific to the CVFPP, as described in detail below.

The 2012 CVFPP goals provide direction on development of the CVFPP to meet legislative requirements, address identified problems, and contribute to the overarching FloodSAFE goals, described in detail below. Primary and supporting goals defined for FloodSAFE and for the CVFPP are also discussed.

5.1.1 FloodSAFE Goals

The FloodSAFE initiative includes a broad range of goals and objectives, as described in the draft *FloodSAFE Strategic Plan* (DWR, 2008a). DWR will work with stakeholders to make the decisions and investments necessary to achieve the FloodSAFE goals, which are as follows:

- **Reduce the Chance of Flooding** – Reduce the frequency and size of floods that could damage California communities, homes and property, and critical public infrastructure.

- **Reduce the Consequences of Flooding –** Take actions before flooding that will help reduce the adverse consequences of floods when they do occur and allow quicker recovery after flooding.

- **Sustain Economic Growth –** Provide continuing opportunities for prudent economic development that supports robust regional and statewide economies without creating additional flood risk.

- **Protect and Enhance Ecosystems** – Improve flood management systems in ways that protect, restore, and, where possible, enhance ecosystems and other public trust resources.

- **Promote Sustainability of Flood System –** Take actions that improve compatibility with the natural environment and reduce the expected costs to operate and maintain flood management systems into the future.

FloodSAFE includes a variety of programs and projects, such as the CVFPP, that will contribute to and collectively achieve the above goals.

5.1.2 Central Valley Flood Protection Plan Goals

DWR, with its partners and interested parties, developed goals to address each of the identified problems (described in Section 4). These goals provide clarity on how the 2012 CVFPP addresses the defined problems, and contribute to the overarching FloodSAFE goals described above, consistent with the legislated intent, as outlined in SB 5. Goal development involved iterative input, review, and comment from multiple sources, including planning area and topic work groups, partners and interested parties, and DWR staff and management. The 2012 CVFPP goals were also shaped by legislative objectives, as codified CWC Section 9616,[12] which describes both structural and nonstructural means for improving the performance and eliminating the levee threat factors of the flood management system. Therefore, the 2012 CVFPP goals provide direction on overall development of the plan.

The 2012 CVFPP goals include (1) the primary goal of improving flood risk management, and (2) supporting goals of improving O&M, improving institutional support, promoting ecosystem functions, and promoting multi-benefit projects. These goals are presented below.

[12] See the *2007 California Flood Legislation Summary* (DWR) and *2007 California Flood Legislation Companion Reference* (DWR) for information on legislative guidance (http://www.water.ca.gov/legislation/)

Primary Goal

- **Improve Flood Risk Management –** Reduce the chance of flooding and damages once flooding occurs, and improve public safety, preparedness, and emergency response through the following:
  - Identifying, recommending, and implementing structural and nonstructural projects and actions that benefit lands currently receiving protection from facilities of the SPFC.
  - Formulating standards, criteria, and guidelines to facilitate implementation of structural and nonstructural actions for protecting urban areas and other lands of the Sacramento and San Joaquin river basins and the Delta.

Supporting Goals

- **Improve Operations and Maintenance –** Reduce systemwide maintenance and repair requirements by modifying the flood management systems in ways that are compatible with natural processes, and adjust, coordinate, and streamline regulatory and institutional standards, funding, and practices for O&M, including significant repairs.

- **Promote Ecosystem Functions –** Integrate the recovery and restoration of key physical processes, self-sustaining ecological functions, native habitats, and species into flood management system improvements.

- **Improve Institutional Support –** Develop stable institutional structures, coordination protocols, and financial frameworks that enable effective and adaptive integrated flood management (designs, O&M, permitting, preparedness, response, recovery, and land use, and development planning).

- **Promote Multi-Benefit Projects –** Describe flood management projects and actions that also contribute to broader integrated water management objectives identified through other programs.

The 2012 CVFPP goals reflect the collective views and perspectives of DWR, a broad range of partners, interested parties, and the public on important issues and areas that the CVFPP should address. The goals do not commit the State to implementing projects to address problems outside the SPFC (CWC Section 9603); rather, the State will work with local and regional entities to help identify and coordinate projects that address problems and needs related to integrated flood management within the Central Valley but outside the SPFC. While contributions to the goals may differ from planning area to planning area and project to project, sets of management actions should collectively contribute to each of the goals. The 2012 CVFPP goals are intended to be broad and enduring; consequently, it is not anticipated that the goals will change significantly over time as the plan is updated.

Figure 5-1 illustrates the linkage between the problem statements identified and described in Section 4 and each of the CVFPP goals. This linkage helps to articulate the concise CVFPP goals, which will address the problems that partners came together to solve, and guide the remaining planning steps. It is important to understand that the problems and the goals are intended to be broad statements. Because there are many individual contributing factors for each broad problem statement, various objectives have been developed to better define the planning goals, and many management actions may be identified to address the CVFPP goals.

Goals are described previously as enduring – they will continue to be important into the future. Therefore, as mentioned, 2012 CVFPP goals are not anticipated to change significantly over time. Although the CVFPP will continue to evolve as implementation progresses and updates are completed every 5 years, CVFPP goals are expected to continue to provide lasting direction and focus to integrated flood management efforts in the planning areas.

Figure 5-1. Relationship of Identified Problems to CVFPP Goals

5.2 Guiding Principles

While goals provide direction on "what" the CVFPP should strive to accomplish, guiding principles provide guidance on "how" the CVFPP will be developed and implemented over time. Guiding principles help guide decision making, influence development and selection of actions and policies to achieve CVFPP goals, inform design and implementation of projects, and provide direction when addressing uncertainty, unforeseen issues, and conflicts.

Guiding principles also capture legal and policy topics that need to be considered. In addition, they address characteristics unique to the Statewide Planning Area and institutional environment. Guiding principles listed below were developed with assistance from partners and interested parties and were refined as plan development progressed.

Under these guiding principles, plans developed for the 2012 CVFPP are to accomplish the following:

- **Emphasize integrated flood management approaches to solving problems with a systemwide perspective and a more sustainable approach**—A variety of nonstructural and structural approaches should be used to achieve multiple long-term goals and objectives from a systemwide perspective. This includes selecting approaches that achieve the following goals:
  - Limit the cumulative growth of flood risk to California's people and infrastructure
  - Reduce the long-term costs of operating and maintaining the system
  - Provide projects that can be readily strengthened or enlarged in the future to accommodate climatological or environmental changes
  - Support resilient, diverse, and productive ecosystems
  - Actions should strategically integrate water supply, environmental restoration, recreation, hydropower, and other resource management opportunities.
- **Consider costs and benefits on a systemwide basis –** Local, regional, and systemwide benefits should be considered when evaluating the feasibility of different solutions. Potential costs and benefits should be described within a statewide context, considering the extent to which all residents of California benefit from the associated public investment.

The description of the proposed program should characterize a variety of program costs and benefits to the environment, agriculture, water resources, and other aspects of society. In addition, it should include the program's direct and indirect benefits to public health and safety; to local, regional, and State economies; and to the environment. The description should also consider the costs of long-term management of system features, including conservation elements. Finally, to the extent feasible, the program description should discuss the benefits to society derived from opportunity costs, and recognize intangible environmental benefits.

- **Design solutions appropriate to the assets at risk –** When planning flood management improvements, the inherent differences in both flooding mechanisms and consequences should be recognized, including the types of assets at risk (communities, infrastructure, commerce, and agriculture). Solutions that reduce the likelihood of sudden and catastrophic failures, particularly in areas with vulnerable populations, should be considered. Ways to manage and reduce flood risks and damage in nonurbanized areas, and ways to improve flood protection for small communities, should be considered. The integration of flood risk management with land use planning should be promoted.

- **Promote environmental and agricultural stewardship –** The broad benefits provided by a natural environment and by agriculture should be recognized and considered when improving the flood management system. When formulating integrated flood management approaches, conservation strategies should be considered if such strategies would improve the quantity, biotic diversity, and connectivity of riparian, wetland, floodplain, terrestrial, and shaded riverine aquatic habitats, and the recovery and stability of native species populations should be promoted. Restoration and conservation of a healthy diversity of habitats and species within the flood management system are critically dependent on natural hydrological, geomorphic, and ecological processes. These processes sustain a continually shifting mosaic of habitats and species populations, and plans need to account for habitats that will shift locations over time within the floodplain. The natural processes should be protected and improved, the agricultural and ecological values of floodplain lands should be recognized, and environmental and agricultural stewardship as a public benefit should be promoted.

- **Avoid or reduce adverse impacts –** Flood risk management actions should avoid and reduce potential adverse impacts through appropriate facility planning and siting, enhanced designs, construction methods, and/or facilities operations where feasible. When impacts on hydraulic systems, cultural resources, water supply, or other environmental resources are potentially significant or significant, feasible mitigation measures are proposed. The purposes, operations, and limitations of existing projects and programs should be considered; however, it should be recognized that DWR and the Board reserve the option of making a statement of overriding considerations pursuant to CEQA Guidelines Section 15093 when certifying CEQA documents for project-specific actions.

- **Use interdisciplinary teams at all stages of planning –** Planning and permitting should be coordinated among agencies and project partners, including land use, infrastructure, and conservation stakeholders, as well as private interests and organizations. Planning should also consider multiple geographic scales and time frames for implementation and integration. In addition, during each stage of available funding, the suite of implemented actions should incrementally advance the goals of the proposed program.

- **Engage communities and interest groups in understanding problems and risks, and in formulating solutions –** Meaningful opportunities to participate in the development process for the proposed program and subsequent implementation actions should be provided to potentially affected parties. A common understanding of flood management roles and responsibilities for providing flood protection and assistance during recovery from flood events should be promoted. Opportunities should be pursued to educate at-risk populations regarding flood risks, and to help affected parties better respond to and recover from flooding.

- **Comply with applicable existing laws and regulations –** Numerous State and federal laws, regulations, and executive orders should be considered: CEQA, the National Environmental Policy Act, the Fish and Wildlife Coordination Act, the Clean Air and Clean Water acts, the California and federal endangered species acts, the National Historic Preservation Act, the California Public Resources Code, and a host of other laws and regulations.

5.2.1 Common Themes

A common theme of the guiding principles is that future flood management projects in the Central Valley need to embody an integrated, systemwide approach. This acknowledges the way that, historically, cumulative impacts of modifications to the river basins have often had unintended effects on communities, habitats, and other resources in the Central Valley. Other themes reflected in many of the principles are coordination, cooperation, and information-sharing among agencies and parties involved in flood management, environmental stewardship, land-use planning, and decision making in the Central Valley.

5.3 Legislative Objectives

The 2012 CVFPP has been prepared pursuant to authorizing legislation as presented in SB 5 (2007), and subsequently described in CWC Sections 9612 and 9614 – 9616. Sections 9614 and 9615 provide detailed guidance regarding the required CVFPP content. Section 9616 lists objectives describing structural and nonstructural means for improving the performance and eliminating the levee threat factors of the Central Valley flood management system. These objectives were instrumental in developing the 2012 CVFPP goals. Additional planning objectives reflecting direction provided in the authorizing legislation are to maximize flood risk reduction benefits within the practical constraints of limited available funds, and to the greatest extent feasible, consistent with sound planning practices and public participation requirements, complete the development and adoption of the CVFPP by July 1, 2012, or later date set by the legislature.

Legislative objectives described in CWC Section 9616 are listed below:

- 9616. (a) The plan shall include a description of both structural and nonstructural means for improving the performance and elimination of threat factors for levees, weirs, bypasses, and facilities, including facilities of the SPFC, and, wherever feasible, meet multiple objectives, including each of the following:

    1. Reduce the risk to human life, health, and safety from flooding, including protection of public safety infrastructure.

    2. Expand the capacity of the flood protection system in the Sacramento-San Joaquin Valley to either reduce floodflows or convey floodwaters away from urban areas.

    3. Link the flood protection system with the water supply system.

4. Reduce flood risks in currently nonurbanized areas.
5. Increase the engagement of local agencies willing to participate in improving flood protection, for a better connection between State flood protection decisions and local land use decisions.
6. Improve flood protection for urban areas to the urban level of flood protection.
7. Promote natural dynamic hydrologic and geomorphic processes.
8. Reduce damage from flooding.
9. Increase and improve the quantity, diversity, and connectivity of riparian, wetland, floodplain, and shaded riverine aquatic habitats, including the agricultural and ecological values of these lands.
10. Minimize flood management system O&M requirements.
11. Promote the recovery and stability of native species populations and overall biotic community diversity.
12. Identify opportunities and incentives for expanding or increasing use of floodway corridors.
13. Provide a feasible, comprehensive, and long-term financing plan for implementing the CVFPP.
14. Identify opportunities for reservoir reoperation in conjunction with groundwater flood storage.

6.0 Management Actions

During Phase 2 of 2012 CVFPP development, DWR and its partners focused on identifying, developing, and evaluating individual management actions (some management actions had been previously identified in Phase 1). A management action is a specific structural or nonstructural strategy, action, or tactic that contributes to the CVFPP Goals. Also, management actions may range from potential policy or institutional changes to operational or physical changes to the flood management system. Management actions may address one or more CVFPP goals. Management actions are not intended to be recommendations; rather, they represent a wide array of suggested strategies and actions that were used to form the various approaches. All of the management actions developed during Phase 2 are broad and not location specific, and vary in their level of detail.

6.1 Management Action Identification

Initial management actions were identified using the following:

- Recommendations in previous State, federal, regional, and local flood risk reduction studies and programs in the Central Valley, including sources such as reports from the Comprehensive Study (USACE, 2002), and California Floodplain Management Task Force (2003).

- Technical information from ongoing FloodSAFE and integrated water management efforts, as available, including information from the State Plan of Flood Control Descriptive Document (DWR, 2010a), levee inspection reports, levee evaluation programs, DWR sponsored flood projects, emergency response programs, and floodplain management programs.

Management actions were also solicited and/or received from stakeholders, including partners, interested parties, and the public, during Phases 1 and 2 of CVFPP development:

- Phase 1 included meetings of the Upper Sacramento River, Lower Sacramento River, Upper San Joaquin River, Lower San Joaquin River, and Delta Regional Conditions work groups; Environmental Stewardship, Levee Performance, Operations and Maintenance, and Climate Change Scope Definition work groups; and the Agricultural Stewardship Scope Definition Joint Subcommittee.

- During Phase 2, input was received through Regional Management Actions Work Group meetings and 15 management actions public workshops. Work group members provided input on content of the management actions and where and how management actions could be integrated into different communities. For more information on management action work group meetings, see the Management Actions Report (DWR, 2010d).

While some management actions were proposed during Phase 1 work group meetings and joint subcommittee meetings, Phase 2 included a more direct solicitation of management actions from partners, interested parties, and the public through various communications and engagement activities. These activities included public workshops and Regional Management Actions Work Group meetings for the five CVFPP planning areas (Upper Sacramento River, Lower Sacramento River, Delta, Upper San Joaquin River, and Lower San Joaquin River). The five Regional Management Actions Work Groups each held three meetings between June and November 2010 to support development of management actions.

To facilitate presenting and evaluating management actions, duplicates were eliminated and the remaining identified management actions were grouped thematically into 11 categories:

1. Additional Floodplain and Reservoir Storage.
2. Storage Operations.
3. Flood Protection System Modification.
4. Operations and Maintenance.
5. Ecosystem Functions.
6. Floodplain Management.
7. Disaster Preparedness and Flood Warning.
8. Floodfighting, Emergency Response, and Flood Recovery.
9. Policy and Regulations.
10. Permitting.
11. Finance and Revenue.

6.2 Preliminary Evaluation and Consolidation

Management actions were identified to be carried forward for further consideration in the planning process based on their potential to contribute to the CVFPP goals and on input from the planning area work groups and public workshops. Screening involved classifying management actions to be further developed and refined to formulate the various approaches.

In terms of the scope of its application and effects, a management action can be described as follows:

- **Location Specific** – A management action that implements or modifies a physical feature or its operations in a certain location (e.g., bypass modifications, changes in storage operations, floodproofing structures in the floodplain).

- **Policy Driven –** A management action that implements or modifies a policy, regulation, process, or other institutional arrangement (e.g., building code amendments, changes to financing mechanisms and revenue generation).

Depending how a location-specific management action is implemented in terms of its scale and location, its effects could be systemwide, local, or both.

- **Action with Systemwide Effects –** A management action that implements or modifies a physical feature or its operations in a certain location, resulting in localized and systemwide effects. For example, bypass modifications or changes in storage operations would be associated with a particular place/facility, but would potentially have localized and systemwide effects and flood management benefits.

- **Action with Local Effects** – A management action that implements or modifies a physical feature or its operations in a certain location, resulting in local effects. For example, floodproofing of structures in a floodplain or strengthening of a levee reach would be associated with a particular location, and would have only localized effects and flood management benefits.

6.3 Summary of Management Actions Carried Forward

A final set of 94 management actions, shown in Table 6-1, resulted from the work groups meetings and workshops.

Table 6-1. List of Identified and Retained Management Actions

Management Actions	Location Specific	Policy Driven
Additional Floodplain and Reservoir Storage		
Enlarge existing transitory floodplain storage	✓	
Construct new transitory floodplain storage	✓	
Increase on-stream flood storage capacity by building new storage facilities	✓	
Update/modify/replace existing flood storage facilities	✓	
Increase flood management allocation by expanding existing, on-stream reservoirs	✓	
Increase foothill and upper watershed storage	✓	
Increase flood management allocation by using spillway surcharge	✓	
Increase flood management allocation by expanding existing, or building new, off-stream storage	✓	
Storage Operations		
Establish partnerships to coordinate flood management structure operations	✓	
Increase flood management flexibility through modifying the magnitude/timing of flood reservations in reservoirs	✓	
Increase flood management flexibility through modifications to objective release schedules at flood management reservoirs	✓	
Increase flood management flexibility by implementing conjunctive use programs at flood management reservoirs	✓	
Implement advanced weather-forecast-based operations to increase reservoir management flexibility	✓	
Flood Protection System Modification		
Improve conveyance by addressing flow constrictions	✓	
Increase capacity of existing bypasses	✓	
Modify existing weirs, overflows, or relief structures to improve flood system performance	✓	
Construct new bypasses to improve flood system performance	✓	
Construct new levees to provide flood protection to additional areas potentially affected by flooding	✓	
Raise levees to improve flood system performance	✓	
Construct setback levees	✓	
Construct ring levees	✓	
Improve structural performance and resilience of existing levees	✓	
Construct closure structures	✓	

Table 6-1. List of Identified and Retained Management Actions (contd.)

Management Actions	Location Specific	Policy Driven
Remove and/or deauthorize disconnected, redundant, and nonfunctional facilities of the SPFC	✓	
Operations and Maintenance		
Restore channel form and function to improve O&M and facilitate flood damage reduction	✓	
Perform clearing and snagging within channels	✓	
Perform dredging to remove sediment from channels	✓	
Reuse excess materials derived from channel maintenance	✓	
Develop regional channel vegetation management plans	✓	
Develop an improved encroachment management program endorsed by the State		✓
Improve administration and oversight of levee penetrations		✓
Improve interior drainage	✓	
Protect vulnerable levees and banks through stabilization and erosion repairs	✓	
Revise O&M manuals to be consistent with new and current policies that support multi-benefits of the flood management system		✓
Effectively maintain, operate, and rehabilitate closure structures	✓	
Develop and/or implement structure rehabilitation and repair program	✓	
Develop a long-term sustainable and implementable Levee Vegetation Management Strategy		✓
Ecosystem Functions		
Control runoff through watershed management	✓	
Remove unnatural hard points within and along channels	✓	
Develop hazardous waste and materials management protocols to identify, contain, and remediate potential water quality hazards within floodplains		✓
Operate reservoirs with flood reservation space to more closely approximate natural flow regimes	✓	
Reduce the incidence of invasive species in the flood management system	✓	
Remove barriers to fish passage	✓	
Set back levees to connect rivers to floodplains	✓	
Restore channel alignment (i.e., conduct de-channelization)	✓	
Encourage natural physical geomorphic processes, including channel migration and sediment transport	✓	
Improve the quality, quantity, and connectivity of floodplain, wetland, riparian, woodland, grassland, and other native habitat communities	✓	

Table 6-1. List of Identified and Retained Management Actions (contd.)

Management Actions	Location Specific	Policy Driven
Floodplain Management		
Reduce flood damages through acquisitions, easements, and private conservation programs	✓	
Manage municipal stormwater for regional or systemwide flood benefits	✓	
Coordinate and streamline floodplain mapping to improve consistency of floodplain delineation and assessment of flood risk		✓
Increase flood risk awareness through outreach and education		✓
Provide technical procedural assistance to local agencies for flood mitigation compliance and grant application assistance		✓
Assist in developing local flood management plan updates and provide procedural and technical support for implementation		✓
Increase awareness of and participation in FEMA's Community Rating System insurance-rate adjusting program		✓
Develop mandatory flood insurance programs that are more consistent with the area's risk of flooding		✓
Increase public understanding of FEMA maps and policies		✓
Develop a State program and framework to reduce or eliminate subsidies for repetitive loss properties in flood-prone areas		✓
Construct training levees or levees that subdivide larger basins		✓
Use floodproofing measures	✓	
Improve awareness of floodplain function through outreach and education	✓	
Disaster Preparedness and Flood Warning		
Coordinate flood response planning and clarify roles and responsibilities related to flood preparedness and emergency response		✓
Improve communication and public awareness of emergency response procedures and terminology		✓
Establish standard flood warning systems and procedures		✓
Improve stream gage network for forecasting purposes		✓
Create systemwide levee instrumentation for early warning systems		✓
Floodfighting, Emergency Response, and Flood Recovery		
Protect critical infrastructure corridors from floodwaters	✓	
Expand the State's assistance to maintaining agencies during flood emergencies		✓
Facilitate improved evacuation planning		✓
Develop a post-flood recovery plan for the Central Valley and Delta to improve the coordination and efficiency of post-flood assistance		✓
Streamline the post-flood permitting process for flood system repairs		✓

Table 6-1. List of Identified and Retained Management Actions (contd.)

Management Actions	Location Specific	Policy Driven
Purchase and pre-position floodfighting materials/tools to prepare for flood events	✓	
Integrate environmental compliance and mitigation into floodfights		✓
Policy and Regulations		
Encourage compatible land uses with flood management system and floodplain function		✓
Establish clear triggers or policy for updating flood management-related General Plan elements and other local flood management plan(s)		✓
Update State's designated floodway program		✓
Use Building Standards Code amendments to reduce consequences of flooding		✓
Update the State's floodplain management policy		✓
Encourage multijurisdictional and regional partnerships on flood planning and improve agency coordination on flood management activities, including O&M, repair, and restoration		✓
Develop and implement State criteria and processes for urban flood protection		✓
Develop and implement flood protection criteria outside urban areas		✓
Update State Title 23 standards		✓
Clarify flood management responsibilities for all State and federal, regional, and local agencies.		✓
Permitting		
Develop regional and river-corridor conservation plans, or expand existing regional conservation plans (e.g., regional Habitat Conservation Plans, Natural Community Conservation Plans) for a more efficient and effective regulatory approval process for flood projects		✓
Develop regional advanced mitigation strategies and promote networks of both public and private mitigation banks to meet the needs of flood and other public infrastructure projects		✓
Develop proactive integrated regulatory compliance strategies that streamline permitting activities		✓
Establish memoranda of understanding and/or management agreements between agencies to integrate needs to be served by the flood management system		✓
Provide technical assistance and education on environmental permits		✓
Develop and implement Corridor Management Strategy		✓
Finance and Revenue		
Maximize funding for flood management projects by leveraging federal funding		✓
Leverage funding from multiple projects to improve cost effectiveness and efficiency of flood management projects		✓
Develop funding mechanism for O&M and new flood management improvements		✓

Table 6-1. List of Identified and Retained Management Actions (contd.)

Management Actions	Location Specific	Policy Driven
Establish a methodology for evaluating benefits and costs on a systemwide basis to support economic justification for projects in all community settings		✓
Create a shared strategic pooled money account that pre-funds avoidance/mitigation solutions for O&M impacts on current and future flood facilities		✓
Create a strategic pooled money account that provides funds for land stewardship activities at current and future flood-related mitigation areas in perpetuity		✓

Key:
Delta = Sacramento-San Joaquin Delta
FEMA = Federal Emergency Management Agency
O&M = operations and maintenance
SPFC = State Plan of Flood Control
State = State of California

For a detailed summary of management actions carried forward, see Section 2.5 of the Management Actions Report (DWR, 2010d). The management actions in Table 6-1 were carried forward for use in the preliminary approaches. Not all management actions were explicitly evaluated; rather, the approach evaluations applied a variety of different management actions on different geographic scales and magnitudes to the preliminary approaches. All management actions were carried forward except actions beyond the scope of the 2012 CVFPP alone, and should be (or are being) evaluated as part of other projects or programs. Some examples of these projects or programs are surface storage investigations, the Statewide Flood Management Planning Program and Bay-Delta Conservation Plan (BDCP). Management actions not carried forward are not included in Table 6-1.

7.0 Preliminary Approaches

Development of the 2012 CVFPP included evaluating three significantly different preliminary approaches to flood management in the Central Valley. The preliminary approaches were primarily used to explore different potential physical changes to the existing flood management system and to assist in highlighting the need for policy or other management actions. Evaluating these preliminary approaches highlighted differences in costs, benefits, and overall effectiveness for use in preparing a preferred approach – the SSIA.

This section describes the formulation and evaluation of the three preliminary approaches used to explore the application of physical management actions on regional and systemwide scales. Flood management actions, economic benefits, and policy considerations derived from the three preliminary approaches were used to help formulate the SSIA, which is presented in Section 8.

7.1 Preliminary Approach Formulation Process

Given the geographic scope and range of perspectives on solutions to flood management problems in the Central Valley, thousands of potential alternatives could be formed from the combination of individual management actions. Consequently, a methodology was developed to reduce the number of alternatives to a manageable level while still representing the full range of approaches to resolving the problems and achieving the 2012 CVFPP Goals. This methodology resulted in identification of three fundamentally different approaches, in addition to No Project, for implementing the 2012 CVFPP. These approaches highlight different ways to focus future flood management investments and contribute to the 2012 CVFPP goals in different ways, both in magnitude and geographic scope.

The three preliminary approaches are intended to bracket a potential range of future flood management actions in the Central Valley and address flood problems in fundamentally different ways, not to achieve the 2012 CVFPP goals to the same degree. Information provided through evaluation of these approaches allowed DWR to select better-performing characteristics and avoid poorer performing characteristics from each preliminary approach to assemble the SSIA.

The three preliminary approaches are as follows:

1. **Achieve State Plan of Flood Control Design Flow Capacity –** This approach focuses on improving existing SPFC facilities so that they can convey their design flows with a high degree of reliability based on current engineering criteria. Levee improvements would be made regardless of the areas they protect. This approach provides little opportunity to incorporate benefits beyond flood management.

2. **Protect High Risk Communities –** This approach evaluates improvements to levees to protect life, safety, and property for high risk population centers, including urban and small communities. Levees in rural-agricultural areas would remain in their existing configurations. This approach provides minor opportunity to incorporate benefits beyond flood management.

3. **Enhance Flood System Capacity –** This approach would seek opportunities to achieve multiple benefits through enhanced flood system storage and conveyance capacity, to protect high risk communities, and to fix levees in place in rural-agricultural areas. This approach combines most of the features of the above two approaches and provides more room within flood conveyance channels to lower flood stages throughout most of the system, with additional features and functions for ecosystem restoration and enhancements.

Preliminary approaches are not alternatives from which a single, superior alternative can be selected. Rather, these approaches identify a range of potential physical and operational flood management actions and explore potential tradeoffs in benefits, costs, and other decision-making factors, including corresponding needs of residual risk management actions and necessary policy directives.

7.1.1 Flood Management Elements

Seven major flood management elements were identified that address the key types of improvements that should be made to the flood protection system to meet the 2012 CVFPP goals:

1. **Bypasses –** Includes construction of new bypasses and/or expansion of existing bypasses to reduce peak flows during flood events.

2. **Reservoir Storage and Operations –** Includes forecast-coordinated operations/forecast-based operations (F-CO/F-BO), and flood easements.

3. **Flood Structure Improvements –** Includes major flood structure construction or improvements, and system erosion and bypass sediment removal projects.

4. **Urban Improvements –** Targets a 200-year level of protection (LOP) for urban areas either through individual projects or the DWR Urban Levee Evaluations (ULE) Project.

5. **Small Community Improvements –** Targets a 100-year LOP for small communities.

6. **Rural-Agricultural Improvements –** Includes alternative rural improvements and incorporating the DWR Non-Urban Levee Evaluations (NULE) Project recommendations.

7. **Ecosystem Restoration –** Includes elements such as fish passage improvements, environmental conservation development, river meandering, and other restoration activities.

Table 7-1 shows major elements of the three preliminary approaches. The first two approaches differ significantly regarding improving SPFC facilities. The third approach includes all of the elements of the first two approaches and many additional elements.

Table 7-1. Major Elements of Preliminary Approaches

Flood Management Element	Project Location or Required Components	Achieve SPFC Design Flow Capacity	Protect High Risk Communities	Enhance Flood System Capacity
Bypasses				
New Bypass Construction and Existing Bypass Expansion	• Feather River Bypass • Sutter Bypass Expansion • Yolo Bypass Expansion • Sacramento Bypass Expansion • Lower San Joaquin River Bypass (Paradise Cut) Components potentially include land acquisition, levee improvements, and new levee construction			YES
Reservoir Storage and Operations				
Forecast-Coordination Operations/Forecast-Based Operations	Fifteen reservoirs with Sacramento River Basin and San Joaquin River Basin	YES	YES	YES
Reservoir Storage/Enlarge Flood Pool[1]	• Oroville • New Bullards Bar • New Don Pedro • McClure • Friant			YES
Easements	• Sacramento River Basin – 200,000 acre-feet • San Joaquin River Basin – 100,000 acre-feet			YES
Flood Structure Improvements				
Major Structures	• Intake structure for Feather River Bypass • Butte Basin small weir structures • Upgrade and modification of Colusa and Tisdale weirs • Sacramento Weir widening and automation • Gate structures and/or weir at Paradise Cut • Upgrade structures in Upper San Joaquin bypasses • Low-level reservoir outlets at New Bullards Bar Dam • Fremont Weir widening and improvement • Other pumping plants and small weirs			YES
System Erosion and Bypass Sediment Removal Project	• Cache Creek Settling Basin sediment management • Sacramento system sediment remediation downstream from weirs			YES

Table 7-1. Major Elements of Preliminary Approaches (contd.)

Flood Management Element	Project Location or Required Components	Achieve SPFC Design Flow Capacity	Protect High Risk Communities	Enhance Flood System Capacity
Urban Improvements				
Target 200-Year Level of Protection	Selected projects developed by local agencies, State, federal partners		YES	YES
Target SPFC Design Capacity	Urban Levee Evaluation Program results	YES[2]		
Non-SPFC Urban Levee Improvements	Includes approximately 120 miles of Non-SPFC levees that are closely associated with SPFC urban levees whose performance may affect the performance of SPFC levees	YES	YES	YES
Small Community Improvements				
Target 100-Year Level of Protection	Small communities protected by the SPFC		YES[3]	YES[3]
Target Design Capacity	Non-Urban Levee Evaluation Program results	YES[2]		YES[2]
Rural-Agricultural Improvements				
Site-specific Rural-Agricultural Improvements	Based on levee inspections and other identified critical levee integrity needs			
Target Design Capacity	Non-Urban Levee Evaluation Program results	YES[2]		YES
Ecosystem Restoration				
Fish Passage Improvements	• Tisdale Bypass and Colusa Bypass fish passage • Fremont Weir fish passage improvements • Deer Creek			YES
Ecosystem Restoration and Enhancement	For areas within new or expanded bypasses, contributing to or incorporated with flood risk reduction projects			YES
River Meandering and Other Ecosystem Restoration Activities	At selected levee setback locations in Sacramento and San Joaquin river basins			YES

Notes:
[1] All approaches include Folsom Dam Raise, as authorized.
[2] Actual level of protection varies by location.
[3] Includes all small communities within the SPFC Planning Area.
Key:
SPFC = State Plan of Flood Control

7.1.2 Approach Evaluation

To effectively evaluate the preliminary approaches, available technical tools were used to judge how changes to SPFC facilities would affect systemwide performance while also reducing flood damages, protecting public safety, and restoring degraded ecosystems. As part of an approach evaluation, key quantitative indicators were developed. The indicators were used to assess the performance of the preliminary approaches in various areas, including changes to riverine and Delta flood stages, structure and crop flood damages, and potential for loss of life.

Evaluation and comparison of the approaches were designed to highlight various key questions and policy considerations:

- What are the capital costs and time frames for implementation?
- How will the relative threats to communities be assessed and prioritized?
- Is the approach cost effective in avoiding damages to property and reducing risks to life safety?
- Does focusing investments solely on urban areas and small communities fully meet legislative objectives?
- Is reconstructing SPFC facilities to reliably pass design flows an effective means of achieving desired levels of flood protection for different land uses in the system, and what are the systemwide effects of reconstruction in place?
- How can complementary strategies related to floodwater storage and conveyance capacity enhance local benefits of levee reconstructions to provide broader, systemwide benefits? These strategies include storage operation modifications, operations coordination among multiple reservoirs, expansion and enhancement of weirs and bypass systems, and floodplain management.
- What are the implications and trade-offs for land uses and economic development within the Central Valley?
- How will residual risk be addressed after the project is implemented?

7.1.3 Evaluation Tools

To support development of the 2012 CVFPP, existing and available data and tools were primarily used to help understand the performance of the existing flood management system, and assess the effects of proposed improvements. A series of technical analyses was conducted to evaluate hydrologic, hydraulic, geotechnical, economic, ecosystem, and related conditions within the flood management system. Collectively, the analyses reflect a systemwide approach to analyzing flooding and related conditions, assessing flood risks, and formulating broad regional and systemwide approaches to reducing these risks. These analyses were conducted in the Sacramento River Basin, San Joaquin River Basin, and Sacramento-San Joaquin Delta (Delta).

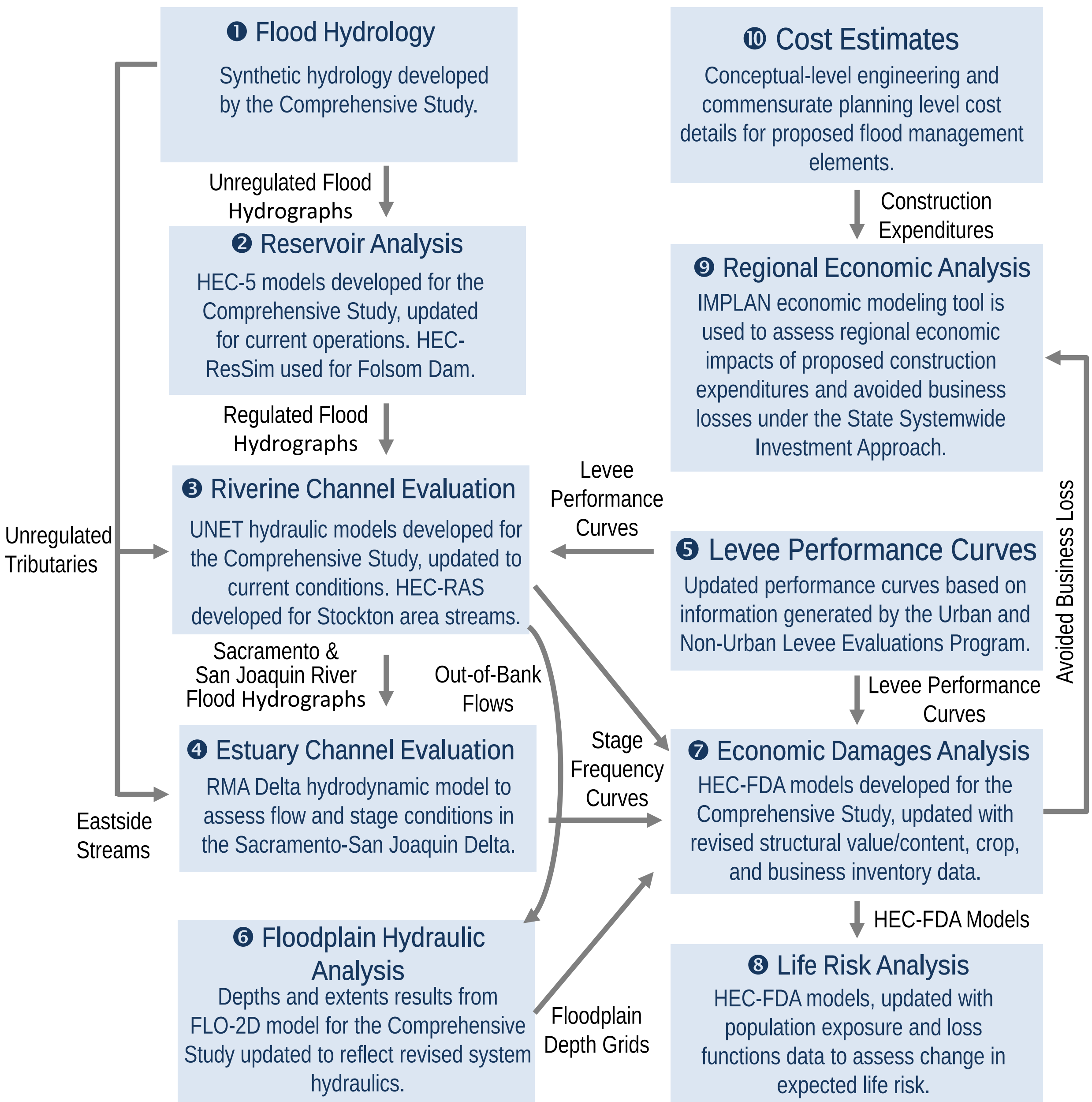
The analytical studies needed to support plan formulation included a series of sequential and parallel evaluations and analyses that are discussed in detail in the 2012 CVFPP Attachment 8: Technical Analysis Summary Report.

The following summarizes the key analytical modeling tools used to support the 2012 CVFPP:

- Synthetic flood hydrology representing existing hydrologic conditions for the Central Valley of California, originally developed for the Comprehensive Study (USACE, 2002).
- Hydrologic Engineering Center 5 (HEC-5) reservoir operations models, originally developed for the Comprehensive Study, to simulate the flood operations of headwater reservoirs and lower basin flood management and multipurpose reservoirs and HEC-Reservoir Simulation (HEC-ResSim) reservoir operations models to simulate releases from Folsom Lake.
- New levee fragility curves developed using geotechnical data from DWR's ULE and NULE programs.
- Updated Comprehensive Study Unsteady Network (UNET) hydraulic models to simulate river stages, flows, and volumes.
- California Water Resources Simulation Model II (CalSim-II) water resources simulations model to explore the simulated effects of reservoir operational scenarios on water supply reliability.
- Resource Management Associates (RMA) Delta hydrodynamic model to determine water surface elevations, and breakout and return flows in the Delta.
- Fullerton, Lenzotti and O'Brien – Two-dimensional (FLO-2D) hydraulic models, originally developed for the Comprehensive Study, to model overbank and floodplain hydraulics to delineate floodplain areas and depths.
- HEC River Analysis System (HEC-RAS) hydraulic models for the Calaveras River, Mormon Slough, and Bear Creek in the Stockton area.

- HEC-FDA economic models, originally developed for the Comprehensive Study, to evaluate flood risk, economic damages, and public safety; updated with population exposure and life loss functions data.

Figure 7-1 illustrates the technical analysis and tools supporting the 2012 CVFPP and flow of information between the various analytical tools and data.



Legend:

Comprehensive Study	*Sacramento and San Joaquin River Basins Study Comprehensive Study (USACE, 2002)*
HEC	USACE Hydrologic Engineering Center
HEC-FDA	HEC Flood Damage Analysis model
FLO-2D	Fullerton, Lenzotti, and O'Brien – Two Dimensional model
HEC-RAS	HEC River Analysis System model
HEC-ResSim	HEC Reservoir Operations Simulation model
HEC-5	HEC Reservoir Operations Simulation model (predecessor to HEC-ResSim)
IMPLAN	Impact Analysis for Planning
RMA	RMA Finite Element Model of Sacramento-San Joaquin Delta hydrodynamics
UNET	One-Dimensional Unsteady Network Flow model (predecessor to HEC-RAS)
USACE	U.S. Army Corps of Engineers

Figure 7-1. Technical Analysis and Tools Supporting 2012 CVFPP Development

As shown on Figure 7-1, the systemwide analysis begins with hydrology, which provides the basis for unregulated flood flows into reservoirs and streams. This is followed by reservoir models to simulate flood operations at the major flood management reservoirs, and hydraulic models to simulate water stages, flow rates, levee breaches, and out-of-bank flows, in both riverine and estuarine environments. Results from the reservoir and hydraulic simulations are used to conduct economic analyses and ecosystem functions studies. Geotechnical levee performance characterizations and other data provide input to the hydraulic and economic models. Conceptual-level design and cost estimates were developed for the proposed flood management features. Change to regional economic output and employment because of the proposed flood improvements was assessed using cost and economic information.

Findings from evaluation of the preliminary approaches, combined with necessary systemwide policies, informed development of the SSIA as the State's proposal for balanced, sustainable flood management in the Central Valley. Figure 7-2 illustrates the basic process followed from identification of the planning goals, through identification of management actions, to formulation of preliminary approaches and the SSIA.

The following sections describe the baseline No Project and the three preliminary approaches in more detail.

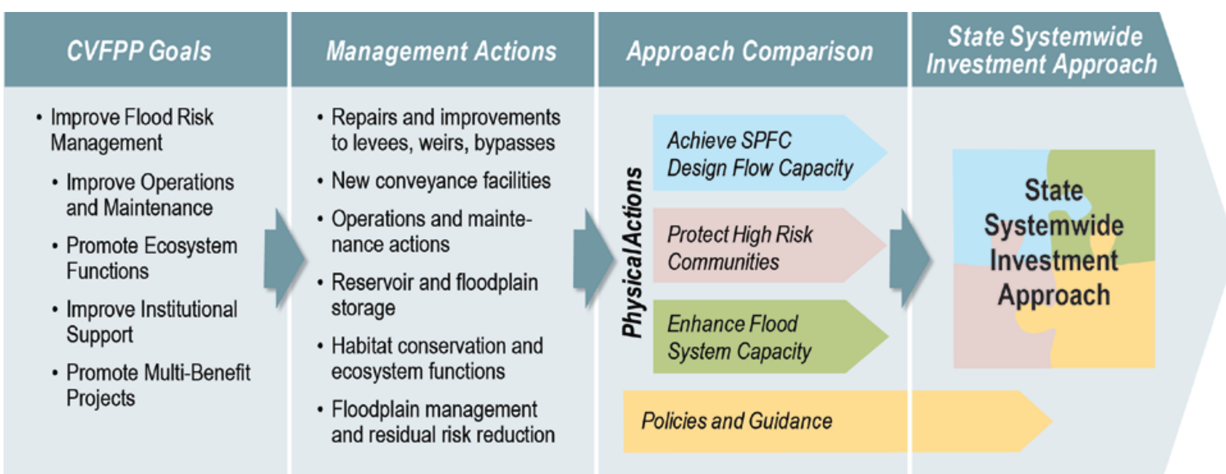


Figure 7-2. Formulation Process for State Systemwide Investment Approach

7.2 No Project

No Project is the baseline for comparing the other preliminary approaches, and simulates conditions that would exist without the adoption of the 2012 CVFPP. This baseline will help determine risk reduction and other benefits of the preliminary approaches and provide a baseline cost for continued routine maintenance.

With "No Project," there would be no systemwide action or program of actions to address the CVFPP goals. No Project assumes a continuation of existing systemwide conditions. Existing systemwide conditions include ongoing routine maintenance of the flood management system, floodfighting and post-flood repairs, and other flood management programs. Also included are projects currently authorized, funded, permitted, and/or under construction, such as the following:

- Levee improvements in southern Yuba County implemented by the Three Rivers Levee Improvement Authority (TRLIA) since 2004 (TRLIA, 2011)
- Natomas Levee Improvement Program by Sacramento Area Flood Control Agency (SAFCA) (SAFCA, 2011)
- Folsom Dam Joint Federal Project to improve the ability of Folsom Dam to manage large flood events by allowing more water to be safely released earlier in a storm event, leaving more storage capacity for capturing peak inflow (Reclamation, 2009)
- Levee improvements along the American and Sacramento rivers to safely pass a flow rate of 160,000 cubic feet per second (cfs) under the American River Common Features Project (SAFCA, 2011)
- Marysville levee improvements
- Authorized elements of the Sacramento River Bank Protection Project
- Feather-Yuba F-CO by the Yuba County Water Agency (YCWA), DWR, the National Oceanic and Atmospheric Administration, and USACE (YWCA, 2008)

This approach does not include any systemwide reconstruction or upgrades. No ecological or habitat restoration projects would be implemented; routine maintenance would continue.

7.3 Preliminary Approach: Achieve State Plan of Flood Control Design Flow Capacity

This approach focuses on reconstructing existing SPFC facilities throughout the system so that the facilities can reliably accommodate established project design flows or design water surface elevations. This approach was formulated to address legislation that required DWR to consider structural actions necessary to reconstruct SPFC facilities to their original design standards (CWC 9614 (g)). It also addresses requests from stakeholders to consider reconstructing the existing flood management system in place, or without major modification to facility locations. This approach does not consider improving SPFC facilities to carry floodflows greater than project design flows, nor enhancements (to levee height, width, or footprint, for example) that exceed current design standards.

7.3.1 Description

The Achieve SPFC Design Flow Capacity Approach includes major remedial actions (facility reconstruction of and modifications to SPFC and appurtenant non-SPFC facilities) to address medium- and high-threat factors identified in the FCSSR (DWR, 2011). Medium- and high-threat factors are those judged to pose the most significant potential threat to SPFC facility integrity. These factors include levee freeboard, levee geometry, structural instability, and seepage, as well as channel capacity to convey design flows. To address these threat factors, this approach includes remediation of approximately 170 miles of urban SPFC levees and 1,400 miles of non-urban SPFC levees. This approach includes remediation of non-SPFC urban levees, as it is recognized that non-SPFC levees can affect flooding within the SPFC Planning Area.

Figure 7-3 illustrates the general locations where some type of levee remediation would be needed to convey SPFC design flows, based on the DWR Levee Evaluations Program ULE and NULE overall hazard classifications and categorizations, respectively. Levees shown as purple (higher concern) or orange (medium concern) on the map generally display more performance problems than those shown in green (lower concern), and require remediation to safely convey SPFC design flows. Remedial actions would include the following:

- SPFC levees would be reconstructed or modified to address identified adverse geotechnical conditions and provide a high reliability of accommodating design flows.
- In locations where the current top-of-levee elevation is less than the design water surface profiles with design freeboard, or where the

channel capacity is less than the stated design flow capacity, levee height would be raised to achieve design freeboard.

Remedial actions would include different types of stability and seepage berms, cutoff walls, rock slope protection, increasing levee height and/or geometry, and replacement levees needed for the system to convey design flows. Under this approach, the O&M of existing reservoirs, weirs, bypasses, and other structures within the flood management system would continue as under current conditions.

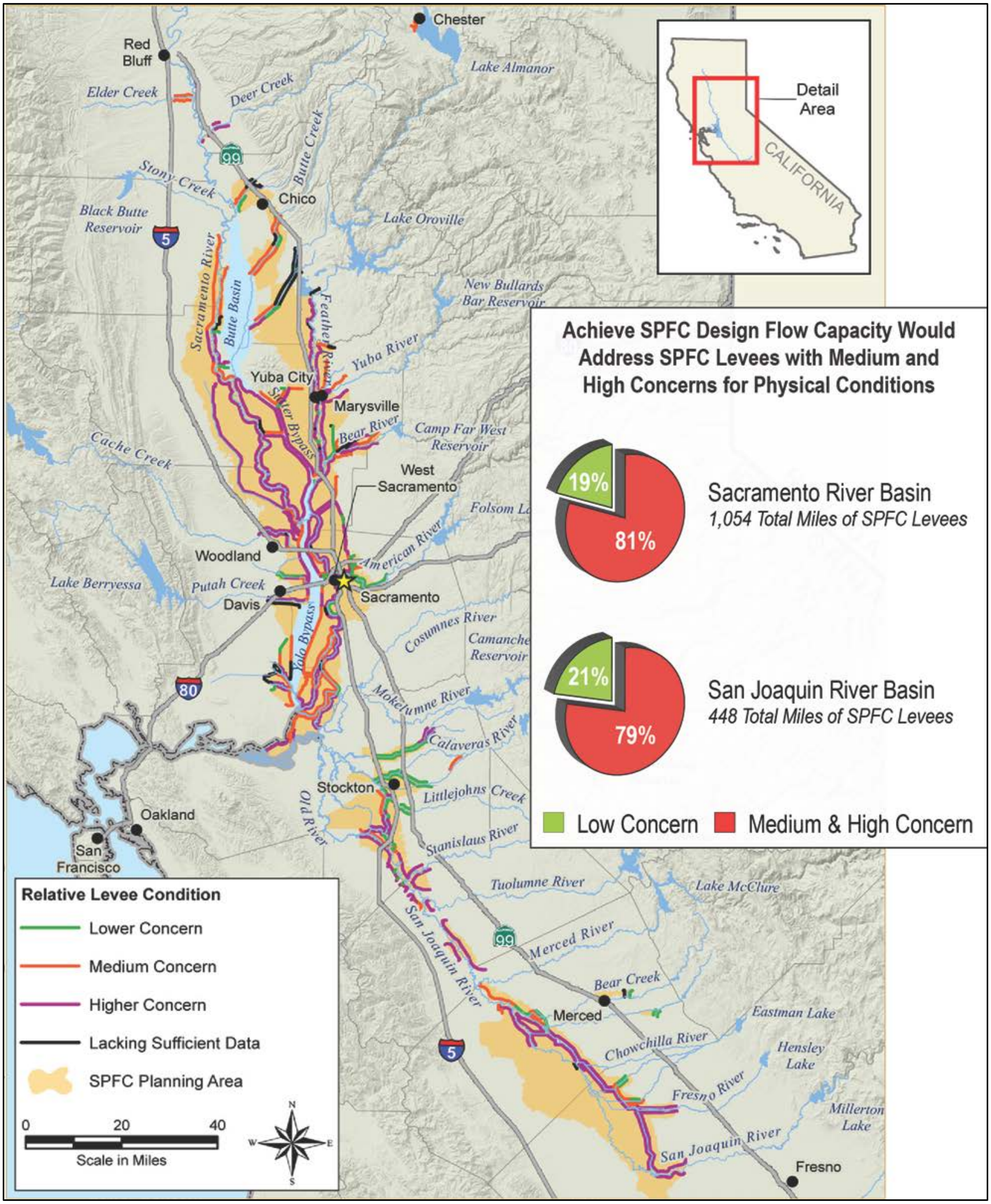


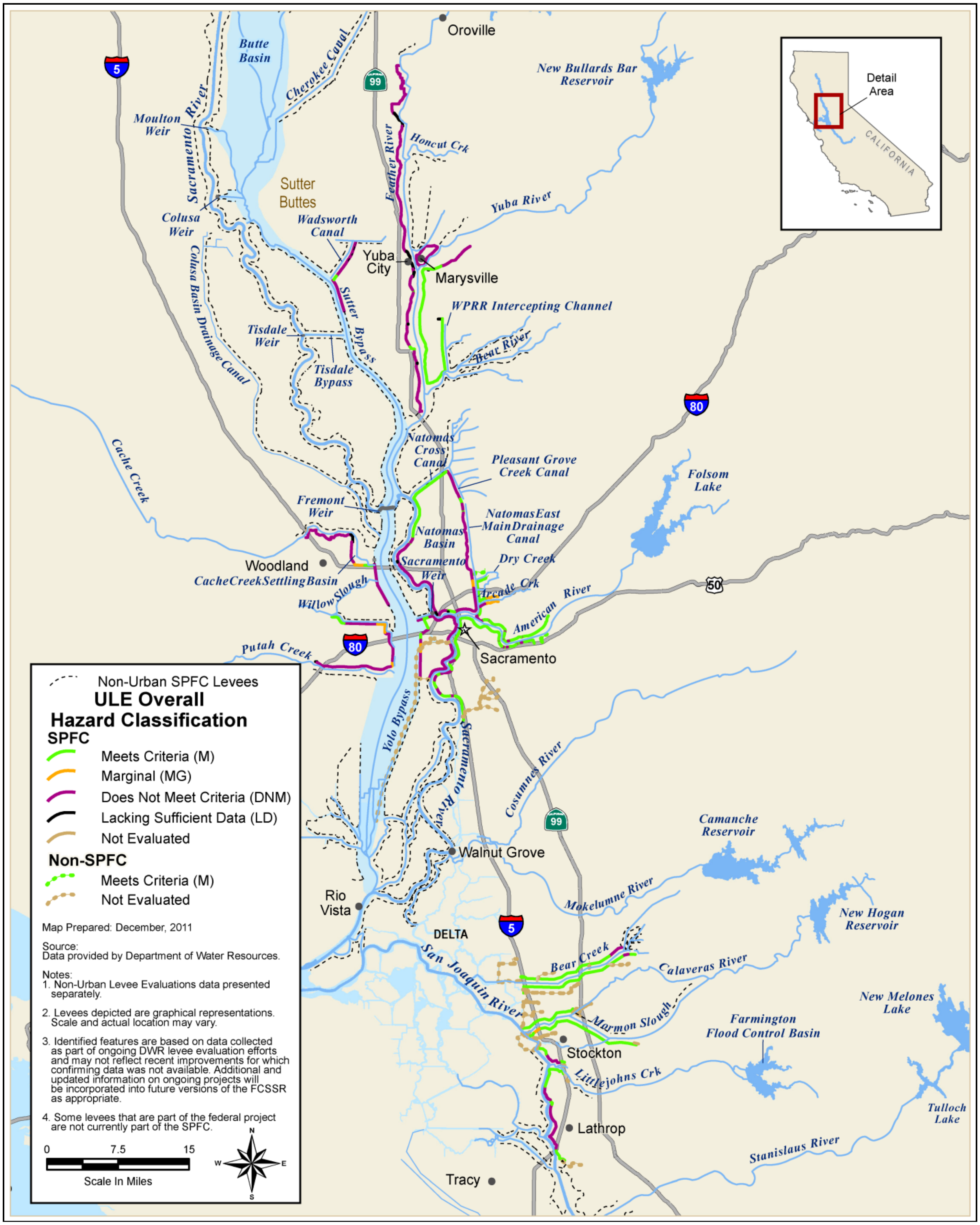
Figure 7-3. Composite Map of Physical Levee Conditions Based on Levee Evaluations Program Results (Urban Levee Evaluations and Non-Urban Levee Evaluations)

7.3.2 Approach Formulation

Under this approach, identified threat factors that adversely affect the ability of the system to safely convey design flows would be addressed via structural methods within the existing facility footprint (in-place reconstruction), where feasible. Overall levee hazard classifications and categorizations for urban and non-urban levees, respectively, are shown in Figures 7-4 through 7-6, based on results from the DWR Levee Evaluations Program. Note that the ULE and NULE results are not comparable because of different methodologies applied for urban and non-urban areas.[1] The ULE and NULE projects are meeting a similar purpose, but urban levees are undergoing a more comprehensive evaluation because of public safety considerations for densely populated areas. No changes in reservoir operations rules or in the way existing weirs and other control structures operate are considered as part of this approach.

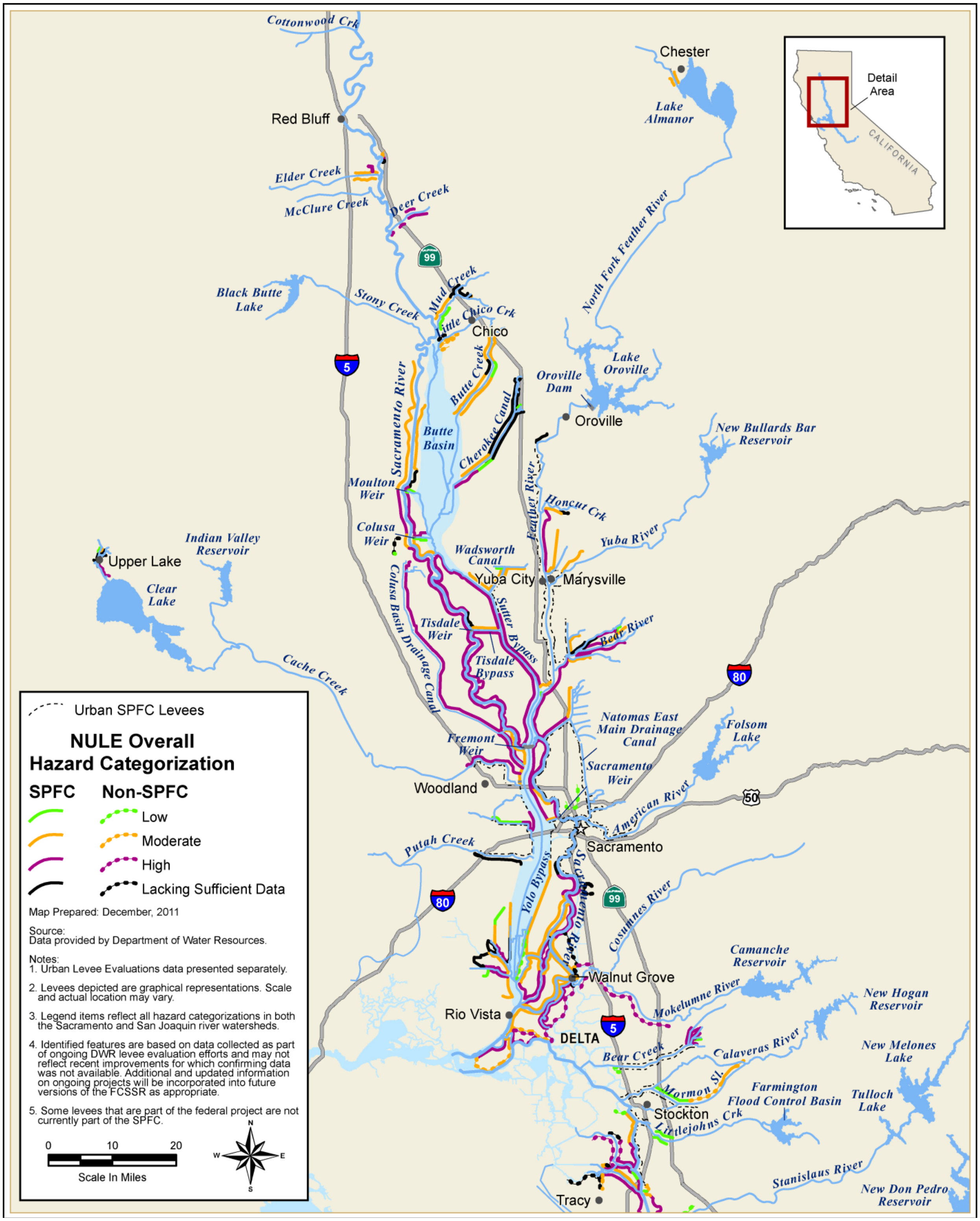
Urban Levees protect densely populated areas

[1] The ULE Project is evaluating urban levees against current design criteria. The NULE Project is evaluating non-urban levees based on systematic, consistent, and repeatable analyses that correlate geotechnical data with levee performance history, and not relative to design criteria.



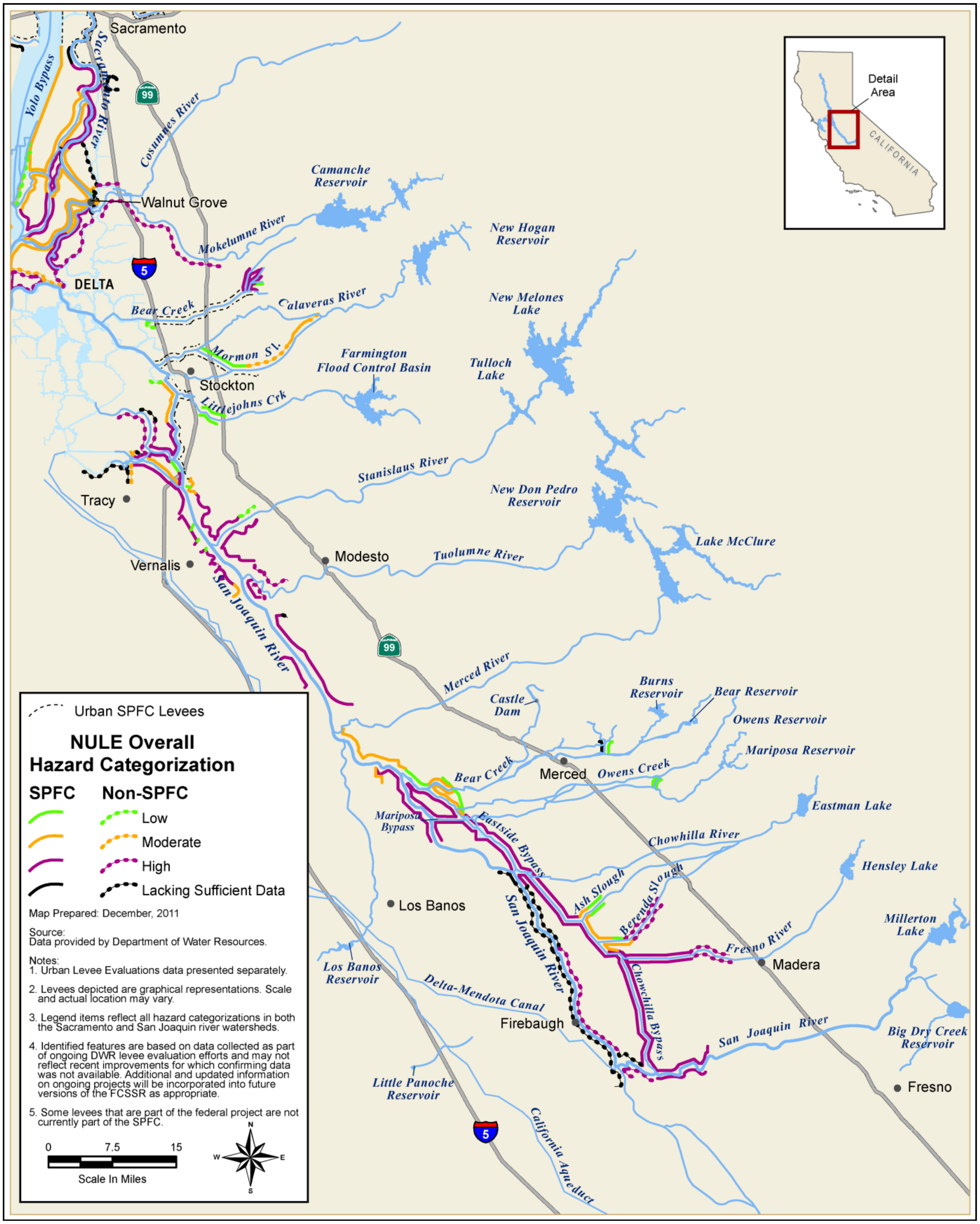
Key: SPFC = State Plan of Flood Control

Figure 7-4. Urban Levee Evaluations Overall Hazard Classification



Key: SPFC = State Plan of Flood Control

Figure 7-5. Non-Urban Levee Evaluations Overall Hazard Categorization for Sacramento River Basin



Key: SPFC = State Plan of Flood Control

Figure 7-6. Non-Urban Levee Evaluations Overall Hazard Categorization for San Joaquin River Basin

To address identified medium- and high-threat factors, the following approaches apply:

- **Levee Crest Elevation (design freeboard) –** In locations where current top-of-levee elevations are higher than, or equal to, design water surface profiles with design freeboard, repairs would be made, where necessary, to address geotechnical and stability factors to accommodate the design profile with high reliability. No increases in levee crest elevation would be considered for these locations. In locations where the current top-of-levee elevations are less than design surface profiles with design freeboard, or where channel capacities are less than stated design capacities, levee raises would be needed to correct for inadequate freeboard. Results of the levee freeboard check conducted by the ULE and NULE projects are described in the FCSSR, Appendix A, Section A-2, and shown in Figures 7-7 through 7-9.

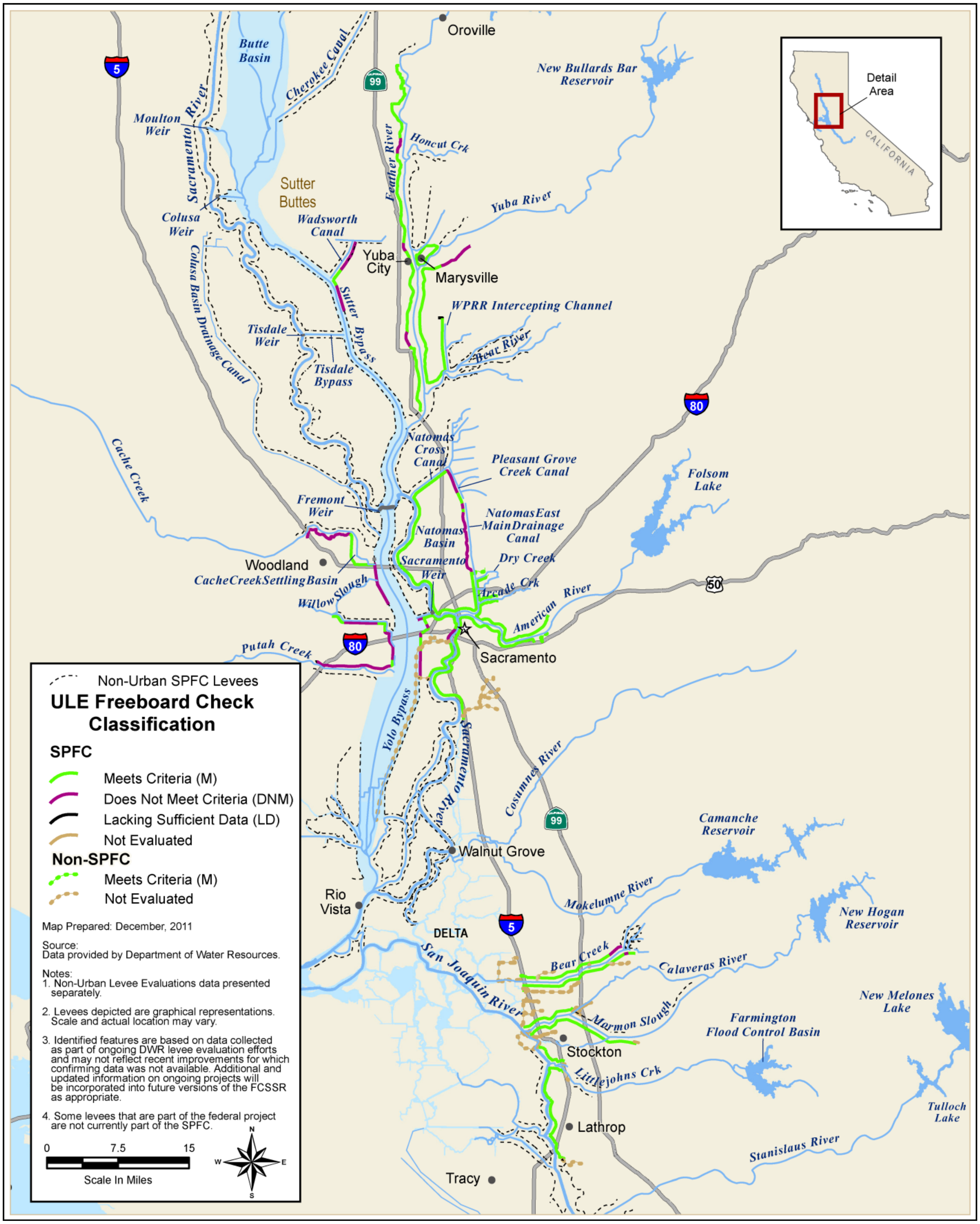
- **Levee Integrity –** The ULE and NULE projects assessed approximately 350 miles of urban and 1,200 miles of non-urban SPFC levees, respectively, and over 500 miles of appurtenant non-SPFC levees. During the preliminary analysis phase and final screening phase of the ULE Project, analyses were conducted to assess the performance of urban levees against identified performance criteria for freeboard, levee geometry, steady-state seepage, and steady-state stability. During Phase 1 of the NULE Project, non-urban levees were assessed for potential for failure from under-seepage, through-seepage, slope stability, and erosion. Results of these assessments for each threat factor are documented in Section 4 of the FCSSR (DWR, 2011a). Based on the ULE hazard classifications and NULE hazard categorizations, levee remediation would be recommended as follows:

  - **Urban Levees –** Levees with hazard classifications of marginal in meeting criteria (MG) or do not meet criteria (DNM) would be recommended to undergo remediation for medium- and high-threat factors. Levees with a hazard classification of lacking sufficient data (LD) would be recommended for further analysis to determine if remediation is required.

  - **Non-Urban Levees –** Levees with hazard categorizations of moderate or high would be recommended to undergo remediation for medium- and high-threat factors. Levees with a hazard categorization of lacking sufficient data would be recommended for further analysis to determine if remediation is required.

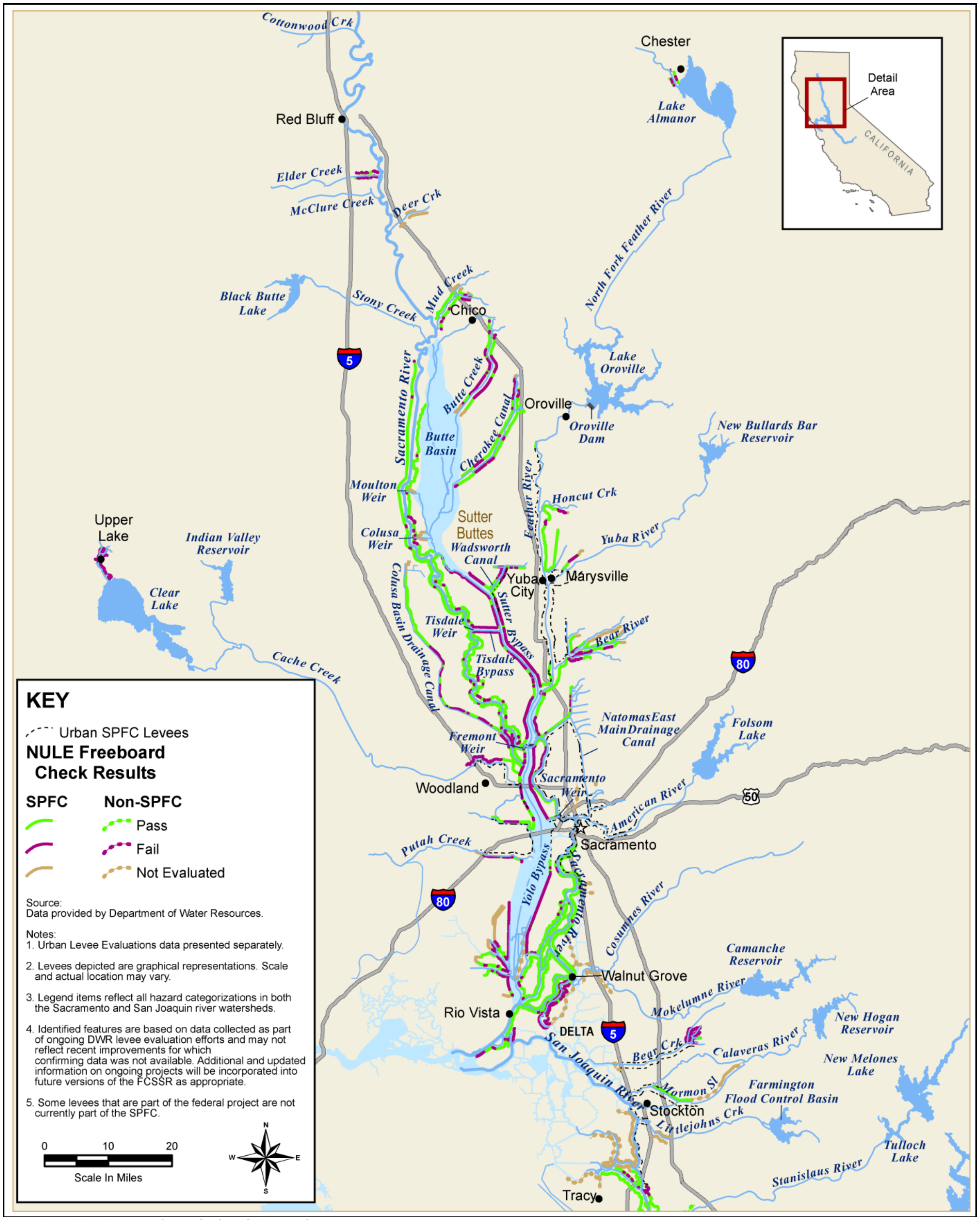
Appurtenant Non-SPFC Levees

Approximately 120 miles of urban, and 400 miles of rural non-SPFC levees were assessed. These levees are generally located immediately adjacent to or opposite SPFC levees such that their function might directly impact that of the SPFC levee system.



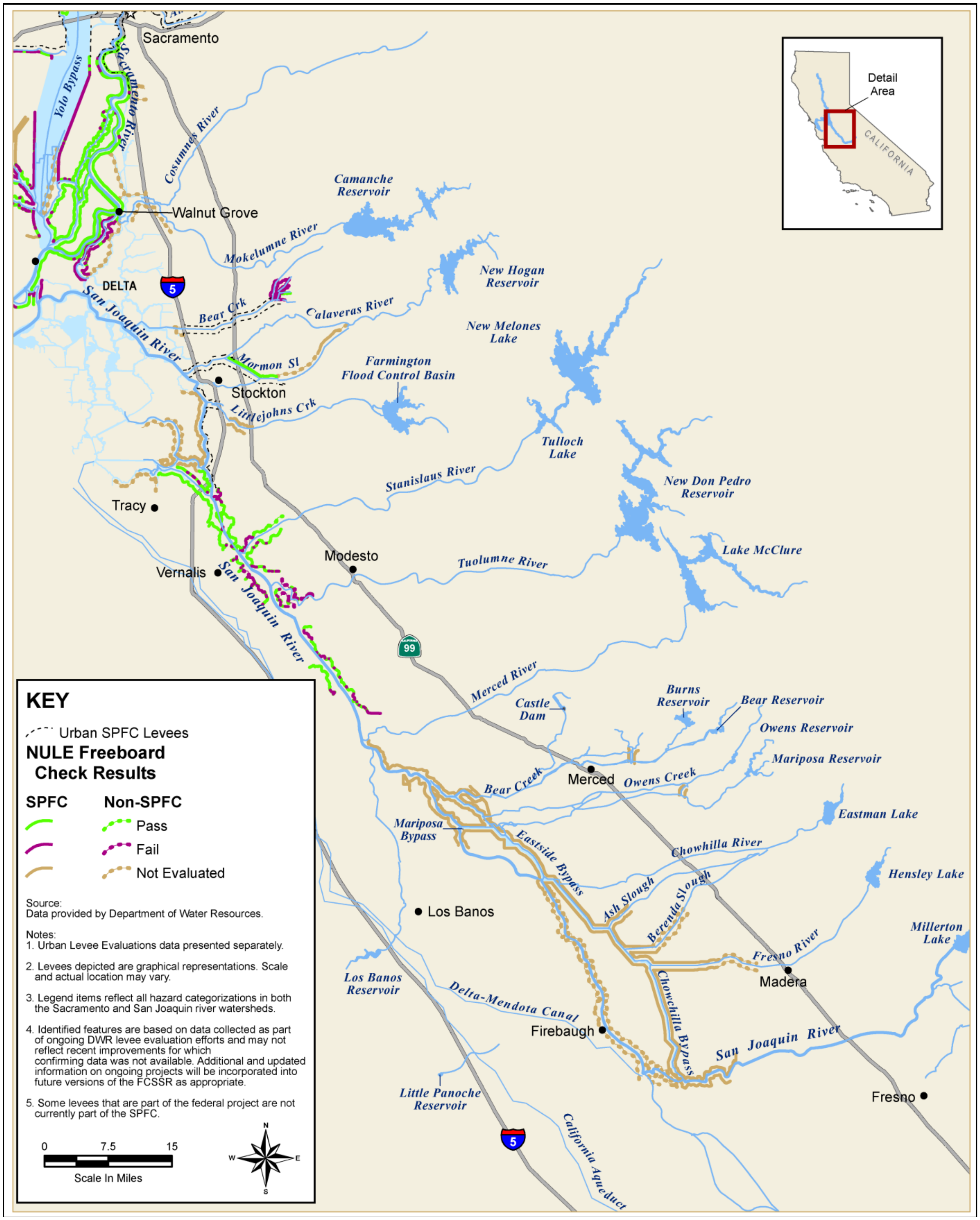
Key: SPFC = State Plan of Flood Control

Figure 7-7. Urban Levee Evaluations Freeboard Check Results



Key: SPFC = State Plan of Flood Control

Figure 7-8. Non-Urban Levee Evaluations Freeboard Check Results for Sacramento River Basin



Key: SPFC = State Plan of Flood Control

Figure 7-9. Non-Urban Levee Evaluations Freeboard Check Results for San Joaquin River Basin

7.3.3 Approach Elements

Types of remedial actions that could be employed to address identified medium- and high-threat factors are listed in Table 7-2. Remedial actions for through-seepage, under-seepage, slope instability, and erosion include constructing different types of stability and/or seepage berms, cutoff walls, rock slope protection, and replacement levees.

Table 7-2. Remedial Actions to Address Identified Medium- and High-Threat Factors

Remedial Action	Levee Threat Factor			
	Through-Seepage	Under-Seepage	Instability	Erosion
Drained stability berm	●		●	
Seepage berm		●		
Combination drained stability and seepage berm	●	●	●	
Conventional soil-bentonite slurry wall (up to 70-foot remediation depth)	●	●		
Deep soil mixing wall (greater than 70-foot remediation depth)	●	●		
Rock slope protection				●
Replacement levee	●		●	

Standardized details were developed for each remedial action to be used as building blocks that could be employed separately or combined with others to provide complete remediation for any set of circumstances. For additional details on this methodology, see Attachment 8J: Cost Estimates. Proposed remedial action quantities for medium- and high-threat factors affecting SPFC urban and non-urban levees are summarized in Tables 7-3 through 7-6.

Table 7-3. Summary of Proposed Remedial Action Quantities to Achieve SPFC Design Flows for SPFC Urban Levees in Sacramento River Basin

Hazard Classification	Total Segment Length (miles)	Structural Remediation (miles)	Erosion Remediation (miles)	Freeboard Remediation (miles)	Other Remediation (miles)
DNM	37.2	23.3	2.7	13.6	0
LD	1.4	0.4	0	1.0	0
MG	2.0	0.6	0	0	0
Total	**40.6**	**24.3**	**2.7**	**14.6**	**0**

Key:
DNM = does not meet criteria
LD = lacking sufficient data
MG = marginal
SPFC = State Plan of Flood Control

Table 7-4. Summary of Proposed Remedial Action Quantities to Achieve SPFC Design Flows for SPFC Urban Levees in San Joaquin River Basin

Hazard Classification	Total Segment Length (miles)	Structural Remediation (miles)	Erosion Remediation (miles)	Freeboard Remediation (miles)	Other Remediation (miles)
DNM	69.0	8.4	0	60.6	0
LD	0	0	0	0	0
MG	0.9	1.0	0	0	0
Total	**69.9**	**9.4**	**0**	**60.6**	**0**

Key:
DNM = does not meet criteria
LD = lacking sufficient data
MG = marginal
SPFC = State Plan of Flood Control

Table 7-5. Summary of Proposed Remedial Action Quantities to Achieve SPFC Design Flows for SPFC Non-Urban Levees in Sacramento River Basin

Hazard Categorization	Total Segment Length (miles)	Structural Remediation (miles)	Erosion Remediation (miles)	Freeboard/ Geometry Remediation (miles)
Moderate	262.2	156.1	72.5	102.6
High	440.9	391.3	201.9	165.8
Lacking Sufficient Data	40.1	23.9	0.0	23.1
Lacking Sufficient Data (Low or Moderate)	13.9	10.1	0.0	10.6
Lacking Sufficient Data (Moderate or High)	18.9	13.9	4.0	8.4
Total	**776**	**595.3**	**278.4**	**310.5**

Key:
SPFC = State Plan of Flood Control

Table 7-6. Summary of Proposed Remedial Action Quantities to Achieve SPFC Design Flows for SPFC Non-Urban Levees in San Joaquin River Basin

Hazard Categorization	Total Segment Length (miles)	Structural Remediation (miles)	Erosion Remediation (miles)	Freeboard/ Geometry Remediation (miles)
Moderate	22.3	9.1	6.4	0.6
High	89.7	62.0	31.8	6.7
Lacking Sufficient Data	0.0	0.0	0.0	0.0
Lacking Sufficient Data (Low or Moderate)	11.8	3.7	9.5	0.2
Lacking Sufficient Data (Moderate or High)	1.1	1.1	0.0	0.0
Total	**124.9**	**76.0**	**47.8**	**7.5**

Key:
SPFC = State Plan of Flood Control

7.3.4 Approach Assessment

Based on an initial assessment, the Achieve SPFC Design Flow Capacity Approach is estimated to cost approximately $19 billion to $23 billion and take 30 to 35 years to implement. This approach would provide an approximate 43 percent reduction in annual flood damages compared to current conditions by correcting identified problems and reconstructing (but not enhancing) SPFC facilities.

This approach would improve the reliability of SPFC facilities compared with existing conditions. Since the original designs did not consider geotechnical and other risk factors addressed by current engineering criteria, reconstruction would significantly improve reliability of the levee system and the LOP provided by the SPFC over that of existing conditions. However, the LOP would be highly variable throughout the system and not linked to the land uses at risk within the floodplain.

Investments in SPFC reconstruction would initially reduce SPFC O&M costs. However, the long-term cost to maintain the system would remain high (similar to current conditions) because reconstruction alone would not address chronic erosion, sedimentation, and other geomorphic conditions inherent to the current system configuration. Consequently, this approach would only partially contribute to the goal of improving O&M.

Details regarding environmental, physical, economic, and life safety assessments of the approach are given below.

Achieve State Plan of Flood Control Design Flow Capacity Approach

- *Reconstruction of approximately 1,600 miles of levees.*
- *Reconstruction of levees in their current footprint to safely pass design flows would contain more floodflows within channels, thus increasing peak floodflows and stages throughout the system.*
- *Reduction of 47 percent in annual flood damage estimates, including structure values and contents and crops.*
- *Estimated capital costs higher for the Sacramento River Basin because of the greater number of levees in the basin.*

Flood Stage Assessment

As mentioned previously, the Achieve SPFC Design Flow Capacity Approach would correct identified problems and reconstruct (but not enhance) SPFC facilities. This approach would improve the reliability of SPFC facilities over existing conditions. Since the original designs did not account for geotechnical problems now known to exist for many levees and their foundations, reconstruction would significantly improve reliability of the levee system and the LOP provided by the SPFC over existing conditions.

This approach would improve the structural integrity of SPFC facilities throughout the system over No Project. However, SPFC facility reconstruction investments would not increase the performance intended by the SPFC over that provided when originally constructed, nor would the investments provide a uniform level of flood protection to any given region or land-use type. Levels of flood protection would continue to vary throughout the system and not all urban areas would achieve the targeted urban level of flood protection as defined in CWC 9602(i).

In some instances, upstream levee reconstruction would result in increased peak flows or stages downstream (see Figures 7-10 and 7-11). Without additional mitigation actions, the level of flood protection in some downstream areas would decrease over current conditions. Consequently, this approach would only partially address the primary CVFPP goal of improving flood risk management.

Physical assessments of the Achieve SPFC Design Flow Capacity Approach were documented in the 2012 CVFPP Supporting Documentation, Technical Documentation. Assessments included hydrologic modeling; reservoir operations modeling; hydraulic riverine, estuarine, and floodplain modeling; and levee performance.

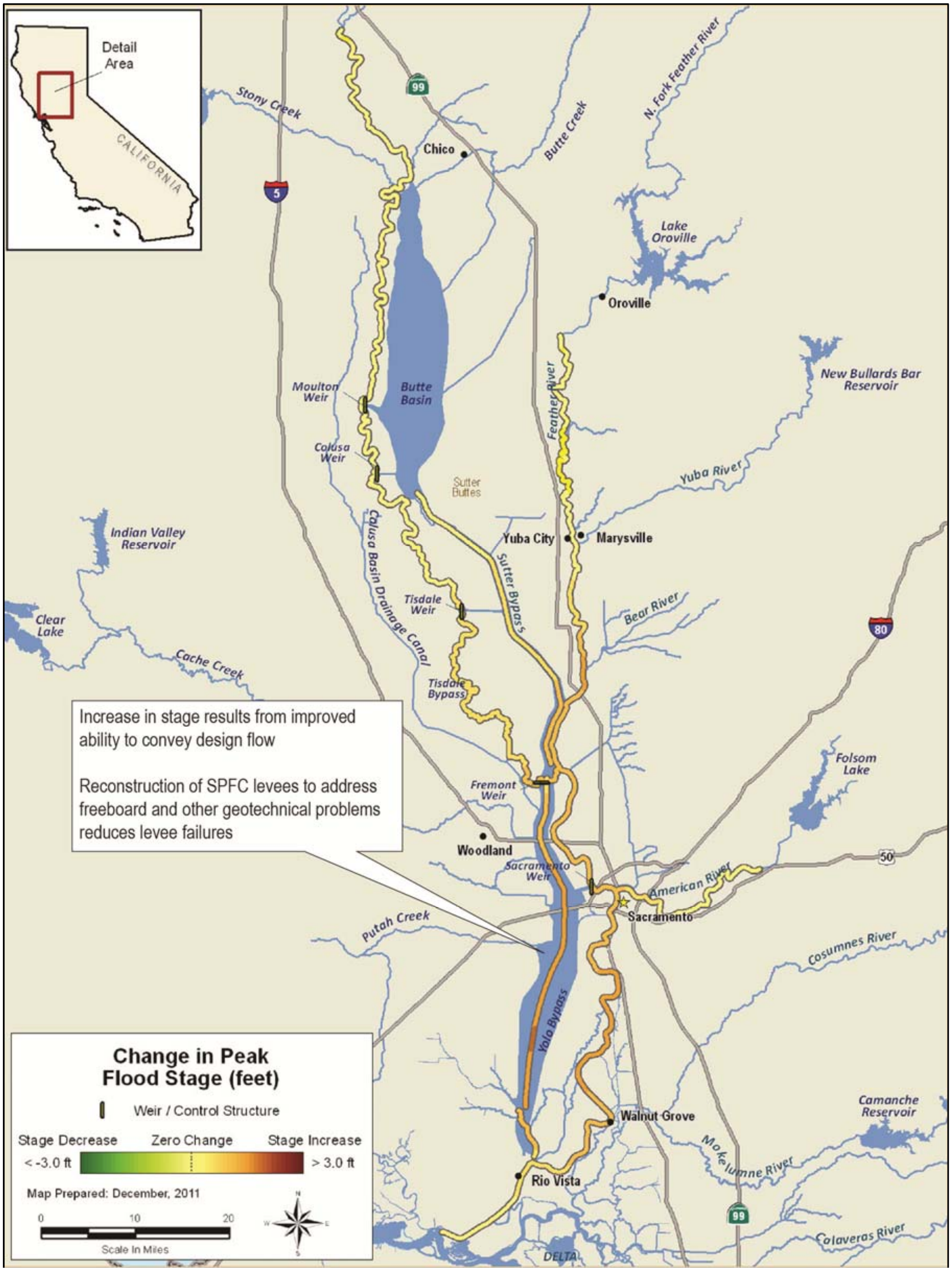


Figure 7-10. Change in Peak Flood Stage for Achieve State Plan of Flood Control Design Flow Capacity Approach Compared to No Project in the Sacramento River Basin (100-year event)

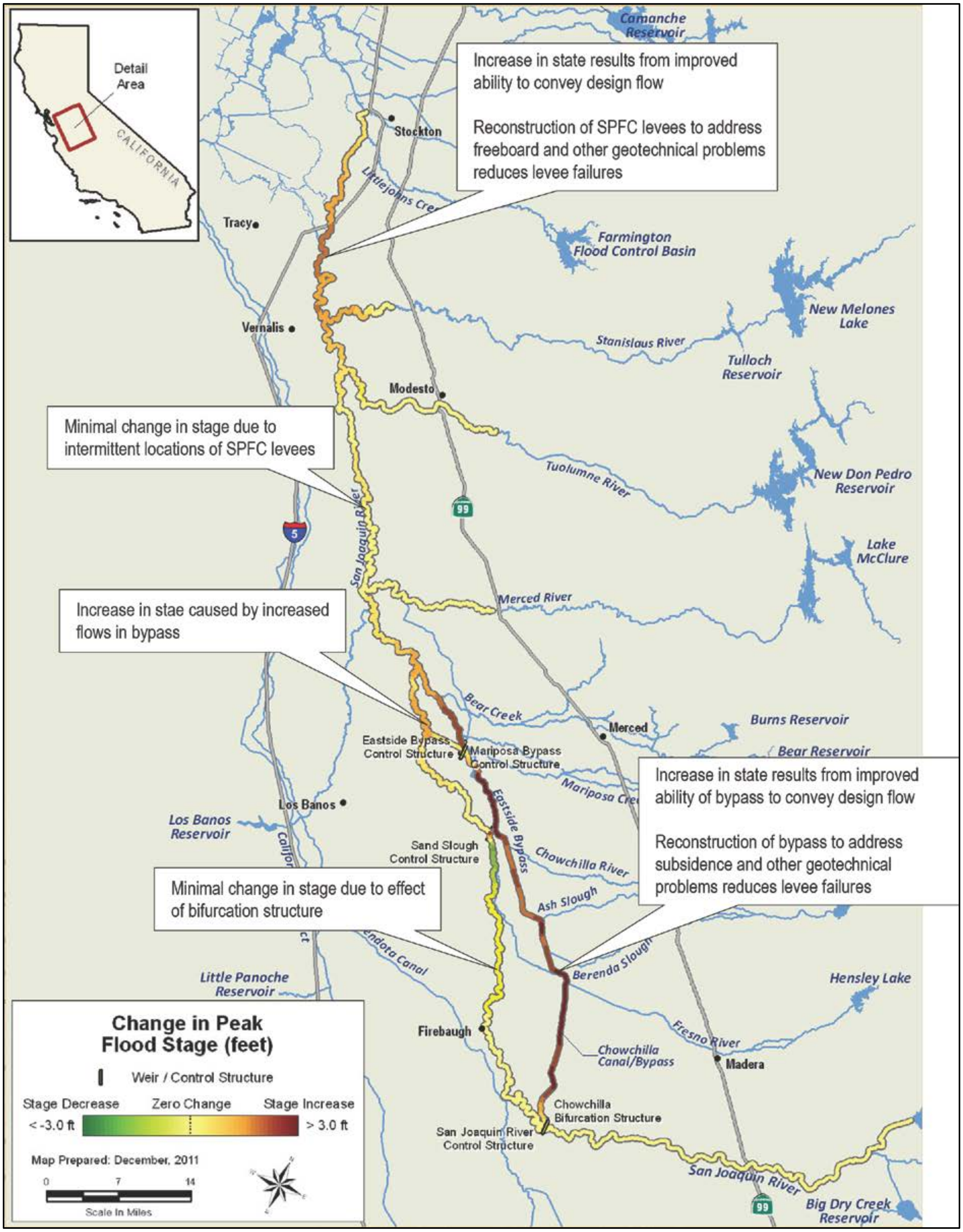


Figure 7-11. Change in Peak Flood Stage for Achieve State Plan of Flood Control Design Flow Capacity Approach Compared to No Project in the San Joaquin River Basin (100-year event)

Environmental Assessment

Because the footprint and operation of SPFC facilities would remain largely unchanged under this approach, opportunities to integrate environmental restoration would be limited (e.g., waterside berms or incorporation of native vegetation into erosion prevention measures along existing levees) and would not result in restoration of ecosystem functions on a systemwide scale. Therefore, existing conflicts between environmental stewardship and levee maintenance practices would continue to hamper the improvement of ecosystem conditions and public safety. There would also be few opportunities to incorporate groundwater recharge or other water-related benefits. Consequently, the approach would have only a minor contribution to the supporting goals of promoting ecosystem functions and multi-benefit projects.

Economics Assessment

Economic assessment for the Achieve SPFC Design Flow Capacity Approach resulted in an initial investment estimate of approximately $19 to $23 billion for correcting identified problems and reconstructing (but not enhancing) SPFC facilities. Investments in SPFC facility reconstruction would initially reduce SPFC O&M costs. However, the long-term cost to maintain the system would remain high (similar to current conditions) because reconstruction alone would not address chronic erosion, sedimentation, and other geomorphic conditions inherent to the current system configuration. Consequently, this approach would only partially contribute to the goal of improving O&M.

Figures 7-12 and 7-14 show the expected annual damages (EAD) for structure and contents, crop, and business losses for the Achieve SPFC Design Flow Capacity Approach compared with No Project for the Sacramento and San Joaquin river basins, respectively. The change in expected damages under the SPFC Design Capacity Approach compared to No Project for the Sacramento and San Joaquin river basins is presented in Figures 7-13 and 7-14, respectively. For both basins, EAD will be reduced significantly compared with No Project.

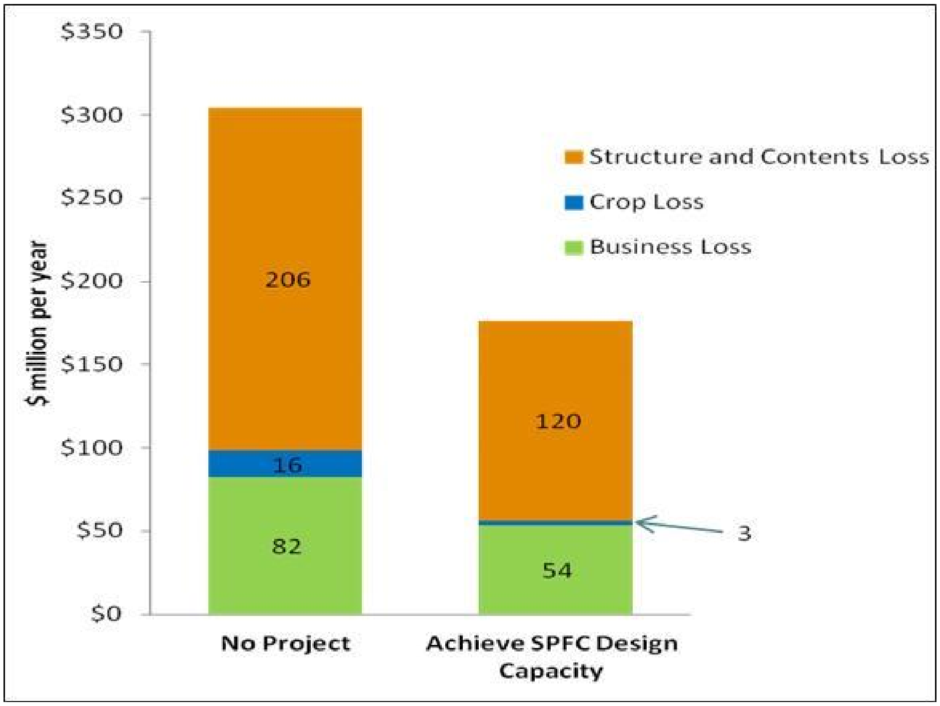


Figure 7-12. Expected Annual Damages from Flooding: Achieve State Plan of Flood Control Design Flow Capacity Approach Compared to No Project for Sacramento Basin

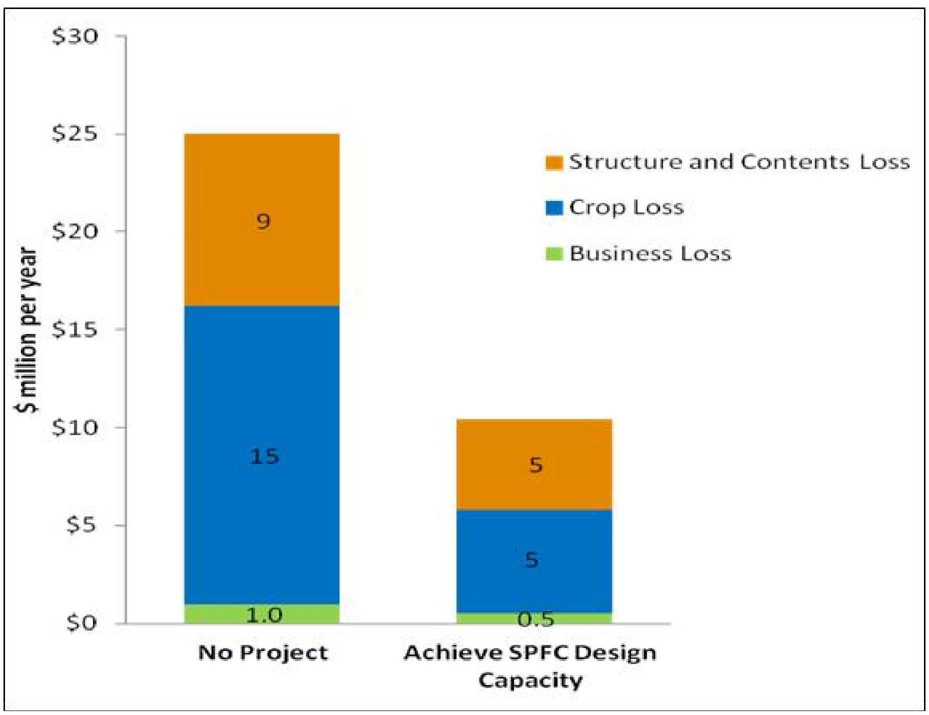


Figure 7-13. Expected Annual Damages from Flooding: Achieve State Plan of Flood Control Design Flow Capacity Approach Compared to No Project for San Joaquin Basin

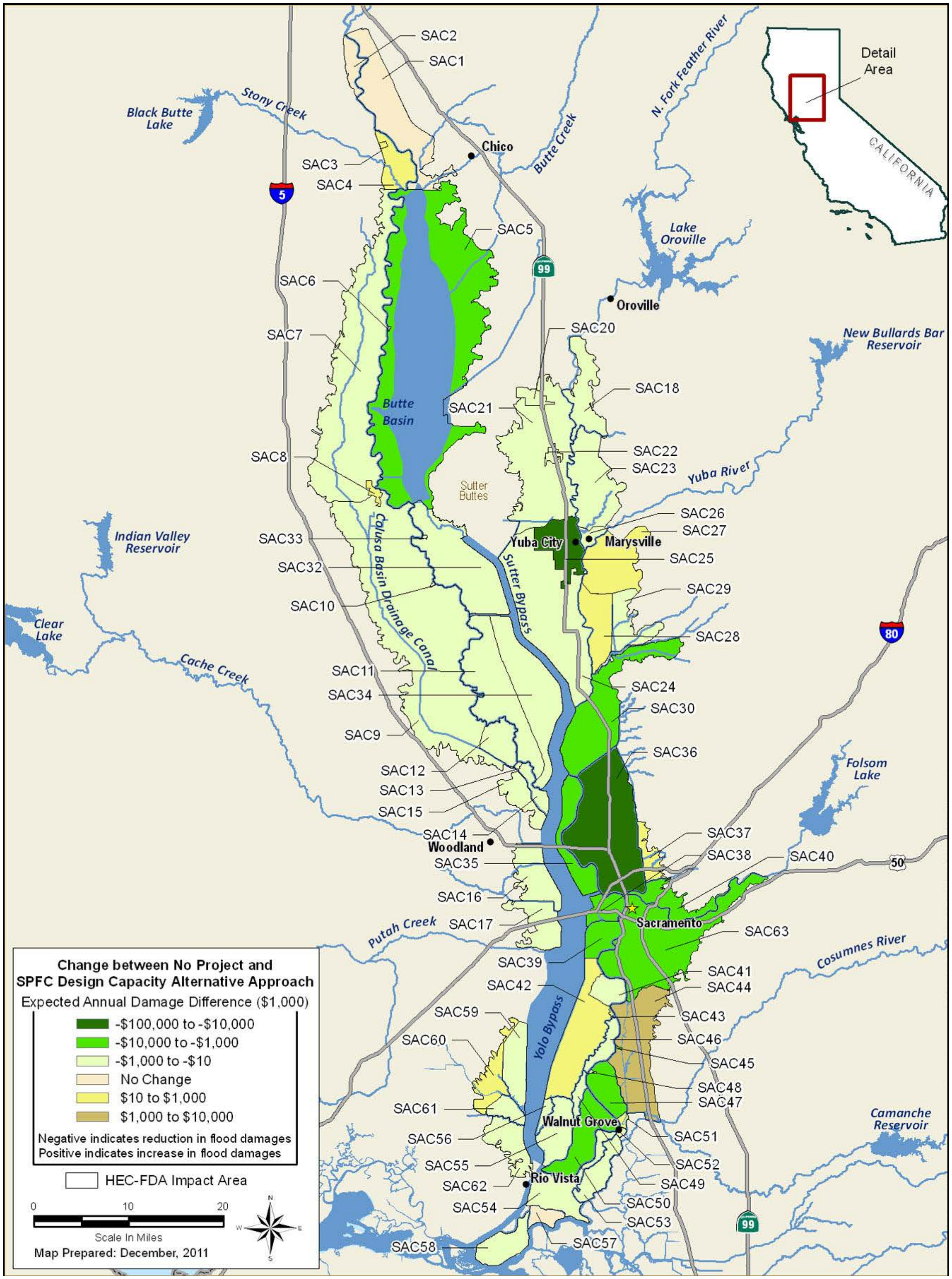


Figure 7-14. Change in Expected Annual Damages for the Sacramento River Basin Under the Achieve State Plan of Flood Control Design Flow Design Capacity Approach Compared to No Project

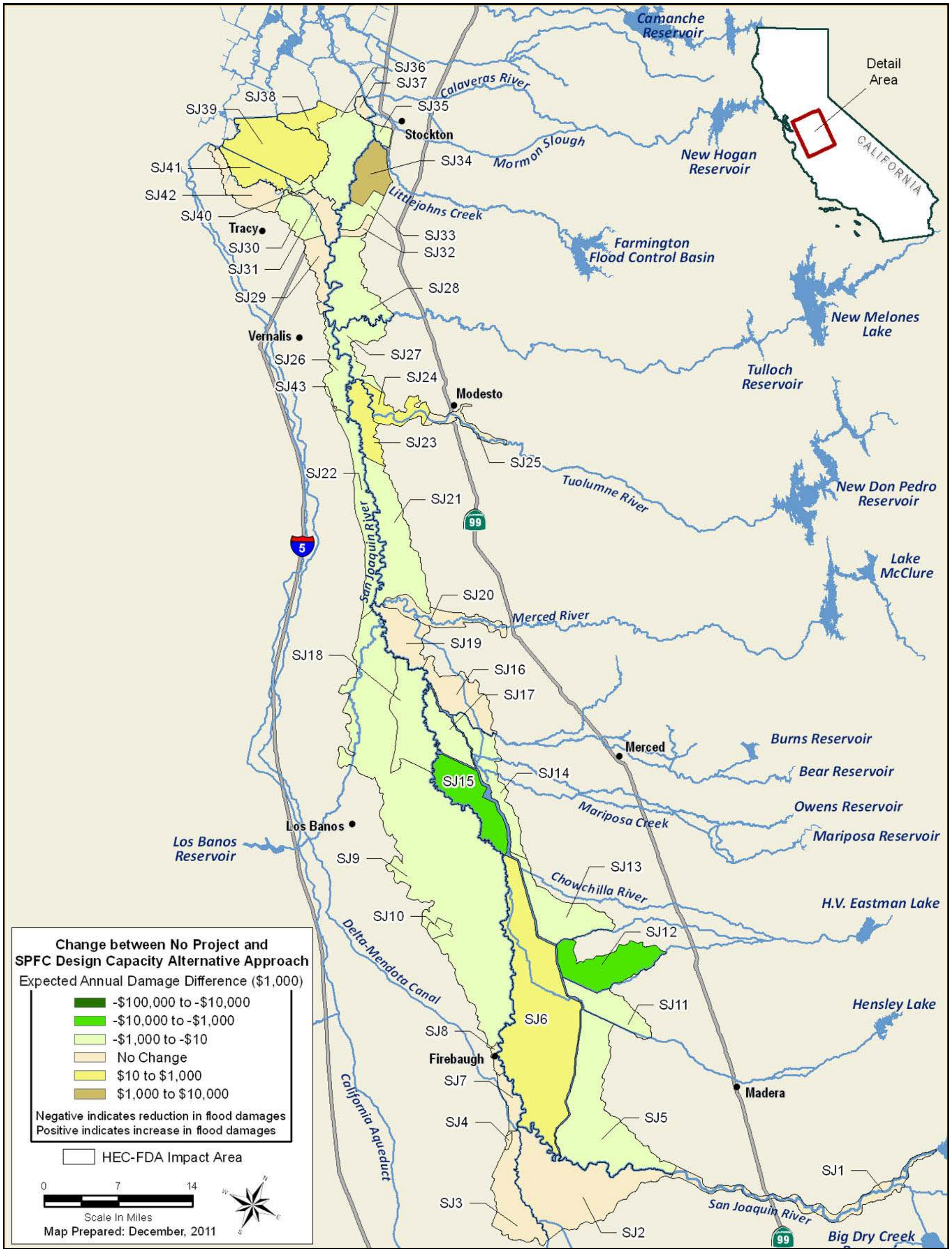


Figure 7-15. Change in Expected Annual Damages for the San Joaquin River Basin Under the Achieve State Plan of Flood Control Design Flow Design Capacity Approach Compared to No Project

Cost Assessment

Cost estimates to repair urban and non-urban levees are developed primarily by ULE and NULE projects. The cost estimates were generated using a Parametric Cost Estimation tool, which developed conceptual-level cost estimates to remediate seepage, stability, and erosion factors. For additional cost details on the estimate approach and assumptions, refer to Attachment 8J: Cost Estimates.

The costs for this approach were categorized into four flood management elements:

1. **System Improvements –** Only costs associated with F-CO/F-BO were included.

2. **Urban Improvements –** Improvements to Urban SPFC Levees through the ULE Program.

3. **Rural Agricultural Improvements –** Improvements to non-urban SPFC levees through the NULE Program.

4. **Residual Risk Management –** This is a minor part of this approach because the repairs to the levees are expected to reduce residual risk.

Table 7-7 summarizes the improvement costs for the Achieve SPFC Design Flow Capacity Approach for the Sacramento and San Joaquin river basins.

Table 7-7. Improvement Costs for Achieve SPFC Design Flow Capacity Approach for Sacramento and San Joaquin Basins ($ Millions)

	Sacramento River Basin			San Joaquin River Basin		
	Low		High	Low		High
System Improvements	$ 43	to	$ 53	$ 48	to	$ 61
Urban Improvements	$ 3,014	to	$ 3,767	$ 813	to	$ 1,017
Rural Improvements	$ 11,095	to	$ 13,869	$ 2,748	to	$ 3,436
Residual Risk Management	$ 485	to	$ 592	$ 247	to	$ 309
Total Costs	$ 14,637	to	$ 18,281	$ 3,856	to	$ 4,823

Because of the greater number of SPFC levees, the estimated capital costs are higher for the Sacramento River Basin than for the San Joaquin River Basin.

7.4 Preliminary Approach: Protect High Risk Communities

This approach focuses primarily on physical improvements to SPFC and non-SPFC facilities to address the highest threats to public safety and property. These threats predominate in densely populated areas, including urban areas and small communities subject to deep or rapid flooding.

7.4.1 Description

This approach includes a variety of physical actions to protect urban areas and small communities from frequent flooding where substantial threats to public safety exist. Flood threat levels were assessed based on population at risk, population density, flood frequency, flood depth, and proximity to main-stem or tributary flood sources. This approach set targets of the following:

- Providing flood protection to urban and urbanizing areas against a 0.5 percent annual exceedence probability (AEP) flood event (1-in-200 chance of flooding occurring in any year), consistent with legislative direction[2].
- Providing flood protection to small communities against a 1 percent AEP flood event.
- The targeted LOP for small communities is considered for planning purposes, and does not represent a State policy or requirement.

This approach addresses the primary goal of improving flood risk management by developing protection from flooding by the main-stem Sacramento and San Joaquin rivers and their major tributaries. Flooding from local sources and interior drainage were not considered in this approach. No facility repairs or modifications would be made to increase the level of existing flood protection in areas where factors would not pose substantial threats to public safety. SPFC facilities would continue to be maintained and repaired as needed (similar to No Project). Secondary goals

[2] All cities and counties within the Sacramento-San Joaquin Valley will be required to make findings related to the urban (200-year) level of flood protection before making certain land use decisions (see California Government Code Sections 65865.5, 65962, and 66474.5). As part of this legislation, DWR is developing policy-level and engineering criteria to help urban level of flood protection to be achieved. Pertinent engineering criteria (such as methods to compute flood depths, and technical standards for levees and floodwalls), are contained in the *Urban Levee Design Criteria* (ULDC) (DWR, 2012) and are incorporated by reference into the policy-level criteria contained in the *Criteria for Demonstrating Urban Level of Flood Protection* (DWR, 2012). Refer to 2012 CVFPP Attachment 3: Documents Incorporated by Reference for more information.

were not addressed in this approach because the approach only provides flood protection as it relates to public safety.

7.4.2 Approach Formulation

Urban communities are defined as communities with populations greater than 10,000 per CGC Section 65007(j). These urban areas are considered high risk communities because of potentially significant public safety consequences that could result from a flood event occurring in densely populated areas. Urban areas would be provided with protection against a 0.5 percent AEP flood event via structural repairs and improvements to levees and other facilities (including levee raises) within their existing footprints, where feasible (in-place reconstruction). Recommended improvements to SPFC urban levees were developed by the ULE Project.

Small communities (communities with populations of less than 10,000) would be provided with protection against a 1 percent AEP flood event via reconstruction of existing SPFC levees or construction of new ring levees. Communities with populations of less than 200 were not considered. Based on flood threat factors (flood frequency, potential flood depth, and proximity to flooding sources), small communities were grouped into four categories to reflect their relative risk of loss of life. The approach for characterizing flood threat levels is illustrated in Figure 7-16. The threat level categories are as follows:

- **High-Threat Level –** Communities that would be subject to high flooding frequency (greater than 1 percent chance per year) and would be subject to deep flooding conditions (potential flood depths of more than 3 feet on average).

- **Moderate- to High-Threat Level –** Communities that would be subject to high flooding frequency (greater than 1 percent chance per year) would be subject to sheet flooding conditions (potential flood depths of less than 3 feet on average), and could be flooded fairly rapidly (located less than 2 miles from a flooding source).

- **Low- to Moderate-Threat Level –** Communities that would be subject to high flooding frequency (greater than 1 percent chance per year), would be subject to sheet flooding conditions (potential flood depths less than 3 feet on average), and would be more than 2 miles from a flooding source.

- **Low-Threat Level –** Communities that would not be subject to high flooding frequency (less than 1 percent chance per year).

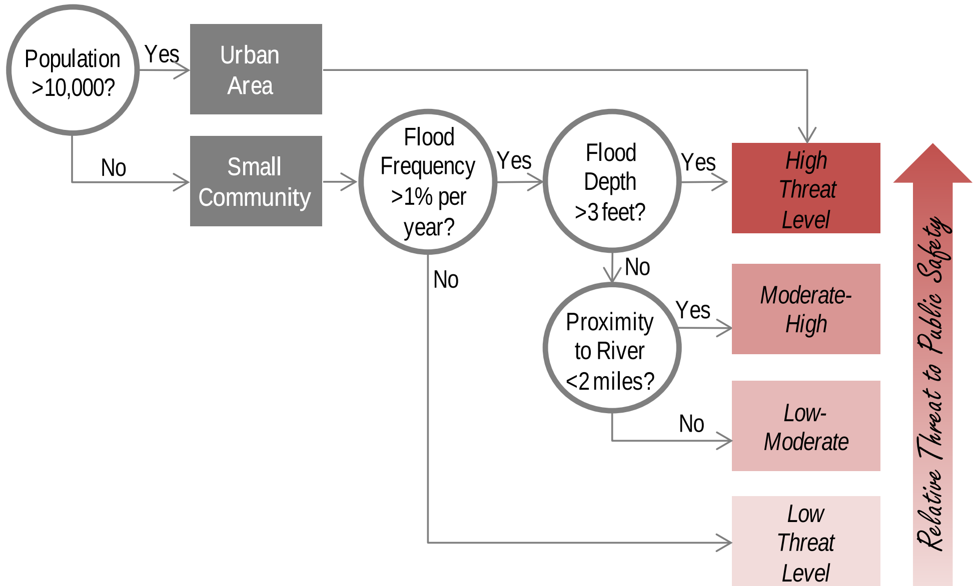
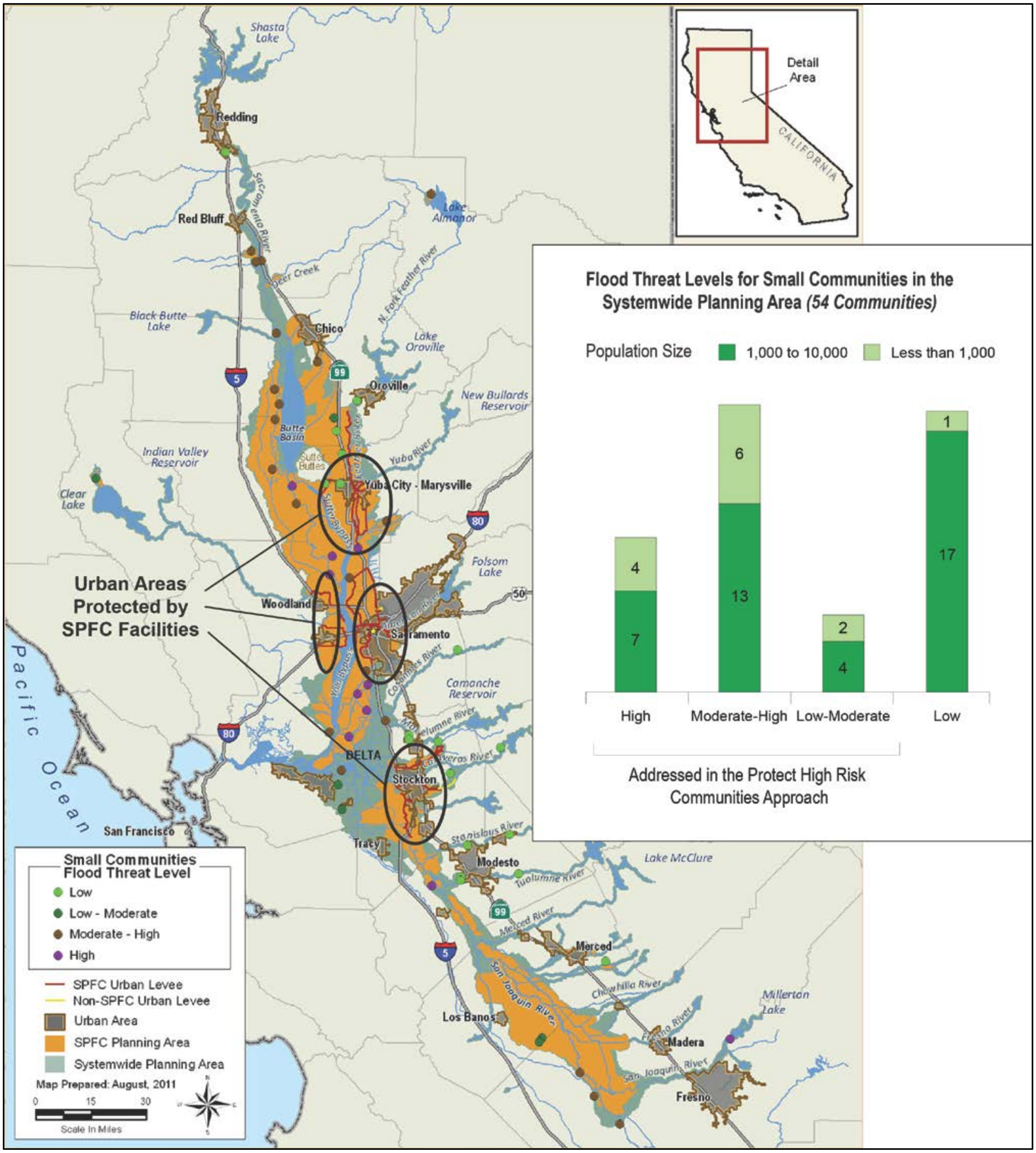


Figure 7-16. Approach for Characterizing Community Flood Risks

Communities with high, moderate-high, and low-moderate flood threat levels would be considered for improvements to their flood protection facilities. Figure 7-17 shows the urban areas and small communities considered in the High Risk Communities Approach.



Key: SPFC = State Plan of Flood Control

Figure 7-17. Urban Areas and Small Communities Included in High Risk Communities Approach

Flood Threat Assessment

Both SPFC and non-SPFC small communities within the Systemwide Planning Area were included in the flood threat assessment. It should be noted that non-SPFC urban communities were not discussed in the 2012 CVFPP. A legislative mandate has been passed, that requires that all urban communities in the Sacramento and San Joaquin River Valleys have protection against a 0.5 percent AEP flood event. Upgrades in protection for non-SPFC urban communities in the Systemwide Planning Area are included in this mandate.

Identifying and characterizing community flood threats involved the following steps:

1. **Identify communities –** The following data sources were used to develop a list of communities within the Systemwide Planning Area:

   - California Department of Finance

   - Census-Designated Places (2000 U.S. Census)

   - California List of Places (U.S. Geological Survey topographic quadrangles)

Population information for communities is from the estimated 2007 population based on 2000 U.S. Census projections and California Department of Finance estimates[3].

2. **Characterize flood threats –** To characterize flood threats to communities, attributes related to flood frequency, potential flood depth, and proximity to the nearest river are used:

   - **Flood frequency –** Each community was evaluated to determine if its annual flood frequency exceeds 1 percent. Information on flood frequencies was obtained using the AEP for economic impact areas presented in the Comprehensive Study, Appendix E, Risk Analysis (USACE, 2002). The economic impact areas cover the majority of the Systemwide Planning Area. If a community spans more than one Economic Impact Area, an area-weighted average was calculated.

   - **Flood depth –** Each community was evaluated regarding whether it was subject to deep flooding conditions, which are considered to be potential average flood depths greater than 3 feet. A flood depth of

[3] 2010 Census data was not made available at the time that this assessment was completed, therefore 2007 Census data was used to establish a baseline population from which projections were made.

3 feet was chosen because it is a flood depth threshold of when flooding could reasonably be life threatening. This information is readily available from the DWR LFPZ maps (DWR, 2008c) and is consistent with California Health and Safety Code Section 50465. Information on flood depth was developed using flood depths from the Comprehensive Study 200-year floodplain (USACE, 2002) and the LFPZs (DWR, 2008c).

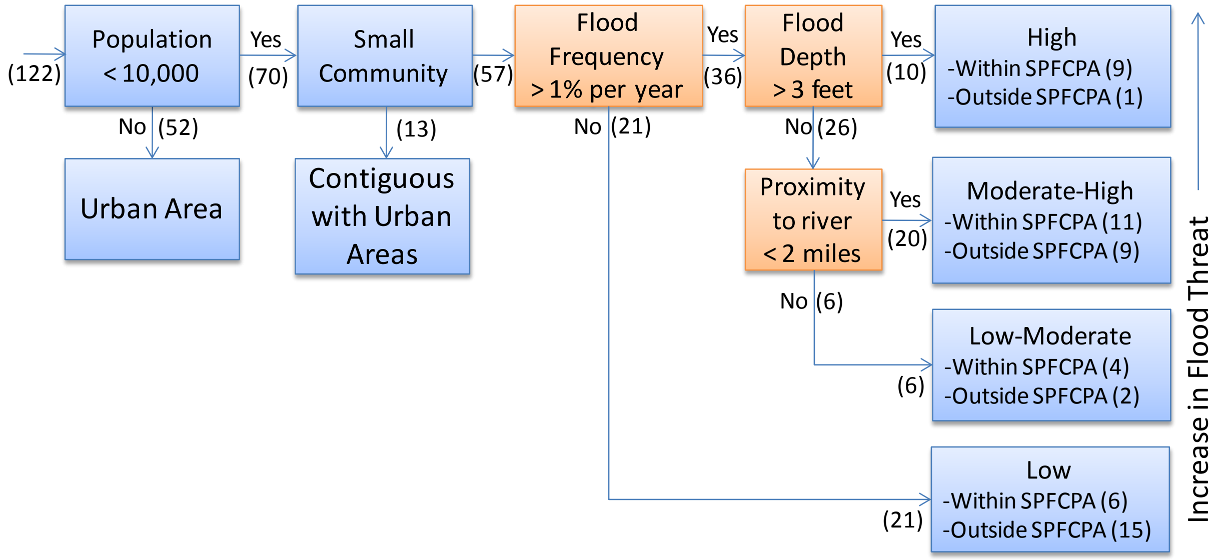
- **Proximity to nearest river –** Each community is evaluated regarding whether it is potentially subject to rapid flooding conditions. Because of the difficulty associated with estimating rapid flooding, for the purpose of this analysis, it was estimated as being within 2 miles of an SPFC levee or other major stream. A proximity of 2 miles was chosen because it is a distance within which flooding could occur quickly. Note that local drainages were not considered.

3. **Assess community flood threat level –** Using the flood threat characterization process (shown in Figure 7-18), community flood threats were assessed. Results are summarized in Figure 7-18 and discussed below:

    - Of 122 unique communities identified within the Systemwide Planning Area, 52 communities were identified as urban (Table 7-8) and 70 were identified as small communities. Of the 70 small communities, 13 were viewed as being contiguous with urban areas, leaving 57 small communities warranting independent consideration in the analysis. Small communities contiguous with urban areas are listed in Table 7-9. Small communities with populations of less than 200 were not considered.

    - All 65 urban communities (52 urban and 13 small communities contiguous with urban communities) were considered to have a high-threat level to public safety from flooding because of their high population density. Small communities contiguous with urban areas were treated as part of the urban metropolitan areas.

    - Of the remaining 57 small communities, 10 were considered to have a high-threat level, 20 were considered to have a moderate-high-threat level, 6 were considered to have a low- to moderate-threat level, and 21 were considered to have a low threat level. Small communities with high, moderate- to high-, and low- to moderate-flood threat levels are listed in Table 7-10.



Legend:
(#) = number represents the number of communities
SPFCPA = State Plan of Flood Control Planning Area

Figure 7-18. Summary of Community Flood Threat Assessment Results

Table 7-8. Urban Areas within the Sacramento and San Joaquin River Basins

Region	Urban Area
Upper Sacramento	• Chico • Red Bluff • Redding
Feather	• Linda • Marysville • Olivehurst • Oroville • Yuba City • South Yuba City
Lower Sacramento	• Arden Arcade • Carmichael • Elk Grove • Fair Oaks • Florin • Folsom • Gold River • La Riviera • Laguna • Laguna West-Lakeside • Parkway-South Sacramento • Rancho Cordova • Rio Linda • Rosemount • Sacramento • West Sacramento • Woodland
Upper San Joaquin	• Atwater • Chowchilla • Livingston • Los Banos • Madera • Merced • Winton
Lower Jan Joaquin	• Antioch • Bay Point • Brentwood • Ceres • Country Club • Discovery Bay • Fresno • Garden Acres • Lathrop • Lodi • Manteca • Modesto • Oakdale • Oakley • Patterson • Pittsburg • Ripon • Stockton • Tracy

Table 7-9. List of Small Communities Contiguous with Urban Areas

	Urban Area				
	Antioch	**Modesto**	**Oroville**	**Sacramento**	**Stockton**
Within SPFC Planning Area		• Bret Harte* • Bystrom* • Shackelford*			• August* • French Camp* • Kennedy* • Lincoln Village* • Morada* • Taft Mosswood*
Outside SPFC Planning Area	• *Sand Hill*		• Palermo	• Gold River • *Hagginwood*	

Notes:
Communities listed from highest to lowest population.
Italicized communities have populations of less than 1,000.
* Communities in the San Joaquin River basin
Key:
SPFC = State Plan of Flood Control

Table 7-10. List of Small Communities by Threat Level

<table>
<tr><th rowspan="2">Planning Area</th><th colspan="4">Flood Threat Level</th></tr>
<tr><th>High</th><th>Moderate – High</th><th>Low – Moderate</th><th>Low</th></tr>
<tr><td>Within SPFC Planning Area</td><td>• Firebaugh*
• Knights Landing
• Grayson*
• Isleton
• Walnut Grove
• Meridian
• Nicolaus
• Courtland
• Robbins
• Hood</td><td>• Colusa
• Durham
• Rio Vista
• Wheatland
• Gerber-Las Flores*
• Glenn
• Clarksburg
• Verona
• Grimes
• Princeton
• Butte City</td><td>• Dos Palos*
• Biggs
• South Dos Palos*
• Upper Lake</td><td>• Live Oak
• Thermalito
• Gridley
• Tierra Buena
• Lockeford*
• Sutter</td></tr>
<tr><td>Outside SPFC Planning Area</td><td>• Friant*</td><td>• Mendota*
• Bethel Island
• Chester
• Los Molinos
• Hamilton City
• Thornton
• Tranquillity*
• Tehama</td><td>• Byron*
• Knightsen</td><td>• Anderson
• West Modesto*
• Rancho Calaveras*
• Rancho Murieta*
• Planada*
• East Oakdale*
• South Woodbridge*
• North Woodbridge*
• Del Rio*
• Riverdale Park*
• Linden*
• Hickman*</td></tr>
</table>

Notes:
* Communities in the San Joaquin River basin
Communities listed from highest to lowest population.
Italicized communities have populations of less than 1,000.
Key:
SPFCPA = State Plan of Flood Control

The goal for urban communities is to have protection against a 0.5 percent AEP flood event. This LOP would be provided through in-place levee reconstruction and improvements to related facilities.

The goal for small communities is to have protection against a 1 percent AEP flood event. This LOP would be provided by improving protection facilities, relocating communities outside the 100-year floodplain, or raising communities above the 100-year flood elevation. Improving protection facilities could include strengthening of levees, raising existing levees, and constructing new levees and/or ring levees. Relocating and raising communities is more expensive, requires public support, and is not being evaluated at this time.

Residual risk is the portion of risk that remains after flood control structures have been built. Risk remains because of the likelihood of the measures' design being surpassed by a flood's intensity and of structural failure of the measures. Methods to reduce residual risk include land-use policies, insurance, building codes, floodproofing, emergency response, and other methods. FloodSAFE and FEMA also have programs that can help manage residual risk. These programs may be evaluated in the future.

7.4.3 Approach Elements

As discussed above, urban communities will be provided with protection against a 0.5 percent AEP flood event through in-place levee reconstruction. Approaches to providing protection against a 1 percent AEP flood event vary from one small community to the next, and range from in-place levee reconstruction to construction of ring levees. Table 7-11 summarizes the proposed actions for high risk small communities. Considering limitations in data availability, only 27 small communities were assessed for the CVFPP. They are primarily a subset of the high risk small communities in Table 7-11, but also include a sampling of lower risk communities which would require residual risk related measures, rather than levee improvements or construction.

Table 7-11. Summary of Structural Evaluations for Small Communities

Small Community	Available Data?	Within SPFC Planning Area?	Recommendation	Description
Knights Landing – Option 1	Yes	Yes	Fix in Place	Repair entire levee segments 162, 172, and 217 as described in GAR, with the addition of a levee raise to the entire length of segment 162.
Knights Landing – Option 2	Yes	Yes	Ring Levee	Construct ring levee by tying a new levee to existing levee segments 162 and 217. A portion of 162 would be raised to meet freeboard criteria.
Isleton	Yes	Yes	Ring Levee	Construct ring levee by tying a new levee to existing levee segments 40 and 378. A portion of segment 378 would be raised to meet freeboard criteria.
Courtland	Yes	Yes	Fix in Place	No flood inundation is shown for Courtland. Repair entire levee segments 126 and 131, as described in NULE GAR.
Hood	Yes	Yes	Ring Levee	Construct ring levee by repairing a portion of levee segment 106, as described in NULE GAR, replacing existing levee segments to the south and east, and constructing new levee to the north.
Nicolaus	Yes	Yes	Fix in Place	No flood inundation is shown for Nicolaus. Repair levee segments adjacent to community, as described in NULE GAR.
Walnut Grove	Yes	Yes	Ring Levee	Construct multiple three-ring levees by repairing levee segments in surrounding area, as described in NULE GAR, and replacing existing nonproject levees with new levees.
Robbins	Yes	Yes	Ring Levee	Construct ring levee around town.
Grayson	Yes	Yes	Training Levee/Fix In Place	Repair adjacent levee segment (207) along left bank of San Joaquin River per GAR recommendations, and construct training levee north of Grayson.
Friant	Partial	No	New Levee/Tieback	Construct new levee along left bank of San Joaquin River and tieback levee along western edge of Friant.
Meridian	Yes	Yes	Ring Levee/Fix In Place	Repair adjacent levee segment (115) along left bank of Sacramento River per NULE GAR recommendations, and construct ring levee around rest of town.
Clarksburg	Yes	Yes	Ring Levee	Construct ring levee by repairing a portion of levee segments 303 and 244, as described in GAR, replacing a portion of an existing levee segment to the north and constructing a new levee to the west.
Durham	Yes	Yes	Fix in Place	This area should be considered apart of Chico. At the minimum, repair levee segments 263 and 381, as described in GAR.
Hamilton City	Partial	No	Ring Levee	No levee data are available from NULE GAR. A ring levee would be constructed with new levee.
Mendota	Partial	No	Ring Levee	No levee data are available from NULE GAR. A ring levee would be constructed with new levee on the east, west, and south, and by replacing a portion of existing nonproject levee to the north.

Table 7-11. Summary of Structural Evaluations for Small Communities (contd.)

Small Community	Available Data?	Within SPFC Planning Area?	Recommendation	Description
Glenn	Partial	Yes	Ring Levee	No levee data are available from NULE GAR. A ring levee would be constructed with new levee on the north, west, and south, and by replacing a portion of existing nonproject levee to the east.
Bethel Island	No	No	Not Assessed	Community has been identified by FEMA as being in the 100-year floodplain. However, no flood inundation is shown for Bethel Island. No levee data are available from NULE GAR.
Princeton	No	Yes	Not Assessed	Community has been identified by FEMA as being in the 100-year floodplain. However, no flood inundation is shown for Princeton. No levee data are available from NULE GAR.
Verona	No	Yes	Not Assessed	Community has been identified by FEMA as being in the 100-year floodplain. However, no flood inundation is shown for Verona. No levee data are available from NULE GAR.
Thornton	No	No	Not Assessed	Community has been identified by FEMA as being in the 100-year floodplain. However, no flood inundation is shown for Thornton. No levee data are available from NULE GAR.
Butte City	Yes	Yes	Ring Levee/Fix In Place	Repair adjacent levee segment (68) along left bank of Sacramento River per GAR recommendations, and construct ring levee around the rest of the town.
Colusa	Yes	Yes	Training Levee/Fix In Place	Repair adjacent levee segments (100 and 287) along right bank of Sacramento River per GAR recommendations, and construct training levee to the north and west of Colusa.
Firebaugh	Yes	Yes	Training Levees/ Ring Levees/Fix In Place	Repair adjacent levee segments (5030) along left bank of San Joaquin River per GAR recommendations, and construct training levees to the north and south of Firebaugh, west of the San Joaquin River, and construct two small ring levees east of the San Joaquin River to protect housing subdivision and water treatment facility.
Chester	TBD	No	Not Assessed	Community has been identified by FEMA as being in the 100-year floodplain. However, no data found in GAR and no inundation observed from 100-year floodplain figures.
Los Molinos	No	No	Not Assessed	Community has been identified by FEMA as being in the 100-year floodplain. However, no data found in GAR and no inundation observed from 100-year floodplain figures.
Gerber-Las Flores	Partial	Yes	Fix In Place	Community has been identified by FEMA as being in the 100-year floodplain. However, no inundation observed from 100-year floodplain figures, but GAR contains data for Elder Creek levees.

Table 7-11. Summary of Structural Evaluations for Small Communities (contd.)

Small Community	Available Data?	Within SPFC Planning Area?	Recommendation	Description
Grimes	Yes	Yes	Training Levee/Fix In Place	Repair adjacent levee segment (288) along right bank of Sacramento River per GAR recommendations, and construct training levee south of Grimes.
Rio Vista	No	Yes	Not Assessed	Community has been identified by FEMA as being in the 100-year floodplain. However, no data found in GAR and no inundation observed from 100-year floodplain figures.
Wheatland	Partial	Yes	Fix in Place	Repair levee segments (138, 240, and 154) along the banks of Bear River and Dry Creek. GIS figures do not show 100-year floodplain inundation, and town is built such that is difficult to protect with no knowledge of where floodflows originate.
Tehama	Partial	No	Not Assessed	Community has been identified by FEMA as being in the 100-year floodplain, and Tehama is built such that it can easily be encircled with ring levee. However, GIS figures do not show 100-year floodplain inundation, and GAR only contains data for one levee segment upstream.
Tranquility	Partial	No	Not Assessed	Community has been identified by FEMA as being in the 100-year floodplain, and Tranquility is laid out such that is easy to encircle with ring levee. However, GIS figures do not show 100-year floodplain inundation, and no data in NULE GAR.
Biggs	Partial	Yes	No Corrective Action Needed	Community has been identified by FEMA as being in the 100-year floodplain. However, no flood inundation is shown for Byron. Levee data are available from NULE GAR; however, it was categorized as low threat so no costs were identified.
Dos Palos/ South Dos Palos	Partial	Yes	Fix in Place	Repair entire levee segments 5028 and 5029, as described in NULE GAR.
Byron	No	No	Not Assessed	Community has been identified by FEMA as being in the 100-year floodplain. However, no flood inundation is shown for Byron. No levee data are available from NULE GAR.
Upper Lake	Partial	Yes	Fix In Place	Community has been identified by FEMA as being in the 100-year floodplain. However, 100-year floodplain maps do not show inundation. Surrounding levees already ring community. Fix existing levees per GAR recommendations, and possibly add a wing/training levee to prevent floodwaters backing up from the south.
Knightsen	No	No	Not Assessed	Community has been identified by FEMA as being in the 100-year floodplain. However, no data found in GAR and no inundation observed from 100-year floodplain figures.

Key:
FEMA = Federal Emergency Management Agency
GAR = Geotechnical Assessment Report
GIS = geographic information system
NULE = Non-Urban Levee Evaluations
SPFCPA = State Plan of Flood Control Planning Area
TBD = To be determined

No changes in reservoir operations rules or how existing weirs and other control structures function compared to No Project were considered as part of this approach. Only structural changes would be made to reach the desired levels of protection for urban areas and small communities. Conservation and environmental restoration elements are not addressed in this approach because the approach only provides flood protection as it relates to public safety.

7.4.4 Approach Assessment

Based on an initial assessment, this approach is estimated to cost about $9 billion to $11 billion and take 15 to 20 years to implement. The approach would provide approximately an approximately 63 percent reduction in mean annual flood damages compared to current conditions. Additionally, levee improvements that are limited to urban areas and small communities would result in minimal change to how the system functions, and to peak floodflows and stages.

Flood Stage Assessment

Although limited, this approach would include the opportunity to improve O&M of SPFC facilities in the vicinity of a number of urban areas and small communities. This would include provisions for local erosion monitoring and problem corrections. However, the long-term cost to maintain the system would remain high (similar to current conditions) because this approach would not address chronic erosion, sedimentation, and other geomorphic conditions associated with the large extent of rural SPFC facilities. Consequently, this approach would only partially contribute to the goal of improving O&M.

Additionally, levee improvements that are limited to urban areas and small communities would result in minimal change to how the system functions, and to peak floodflows and stages (Figures 7-19 and 7-20). Peak floodflows under this approach would not be reduced over No Project flows and in the Sacramento River Basin; a minor increase in peak flows would be seen in some downstream locations because the improved urban levees would keep more water in the floodways, resulting in increased stage in the levee system.

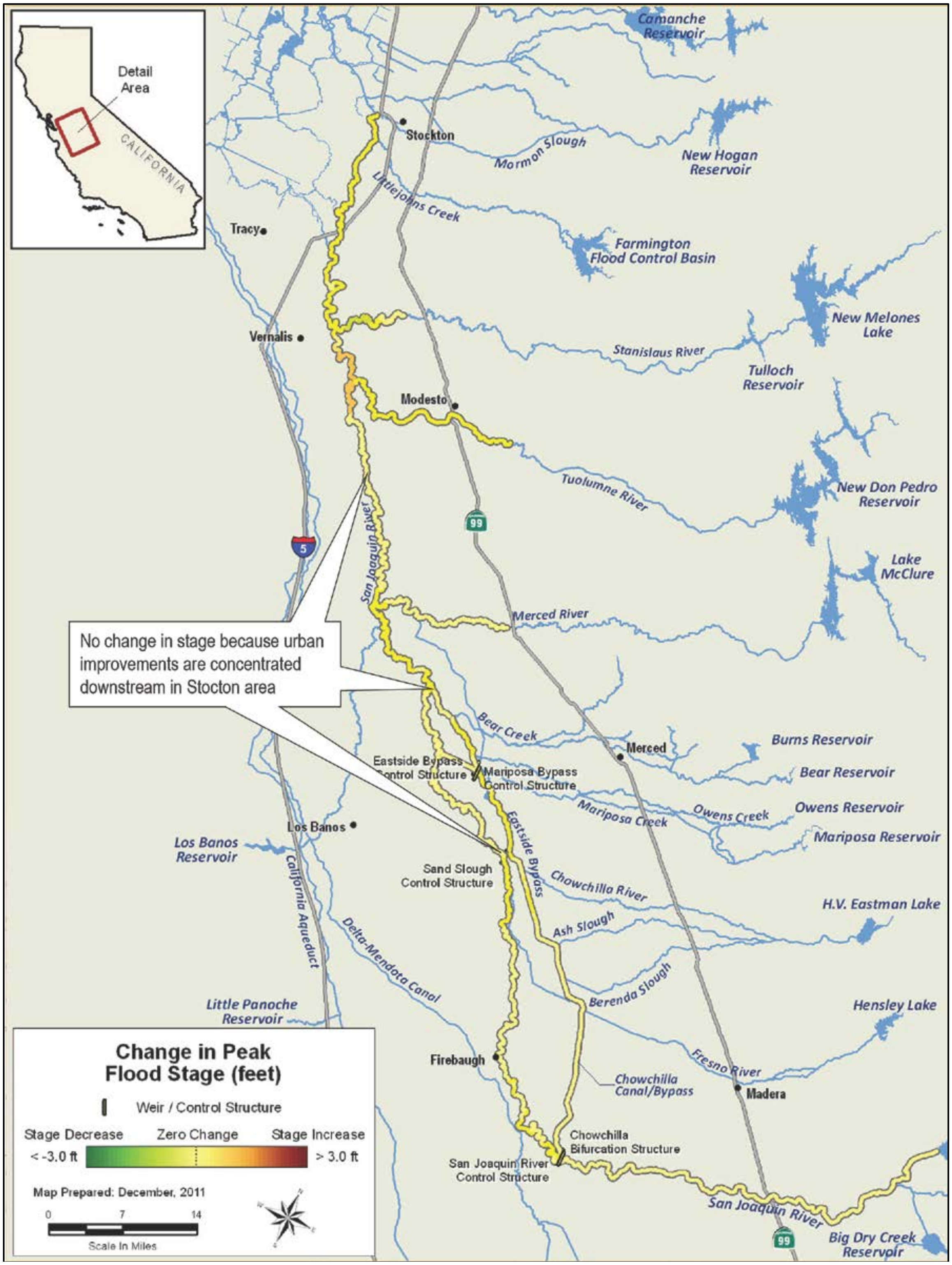


Figure 7-19. Change in Peak Flood Stage for Protect High Risk Communities Approach Compared to No Project in Sacramento River Basin (100-year event)

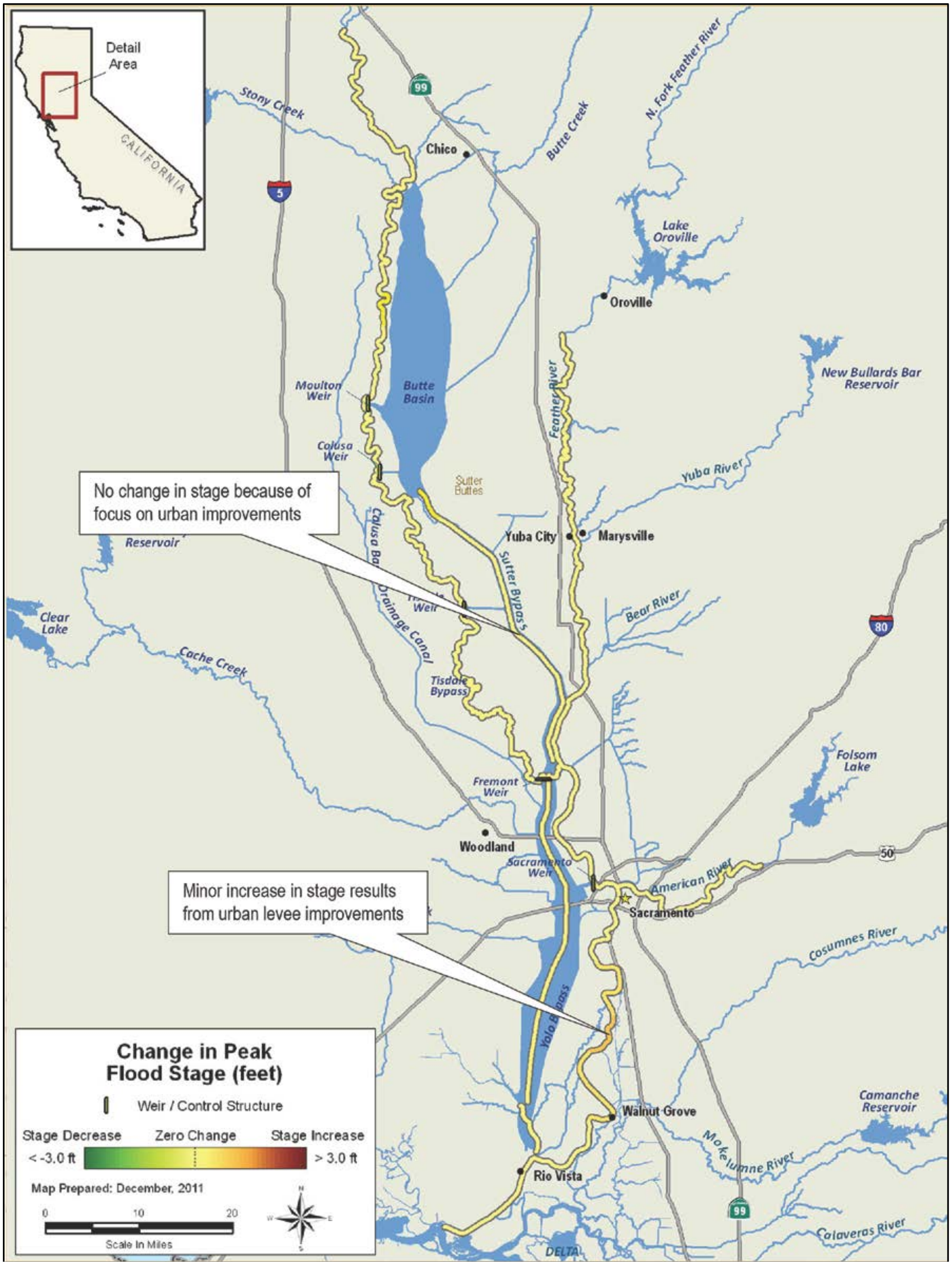


Figure 7-20. Change in Peak Flood Stage for Protect High Risk Communities Approach Compared to No Project in San Joaquin River Basin (100-year event)

Environmental Assessment

This approach would generate some opportunities to integrate environmental features into urban area and small community protection actions, including the construction of waterside berms or incorporation of native vegetation or habitat. However, because these opportunities would largely be site-specific, and because the footprint and operation of the SPFC facility would remain largely unchanged, this approach would not result in the restoration of ecosystem functions on a systemwide scale. There would also be few opportunities to incorporate groundwater recharge or other water-related benefits. Consequently, this approach would have only a minor contribution to the supporting goals of promoting ecosystem functions and multi-benefit projects.

Economics Assessment

Based on an initial assessment, the Protect High Risk Communities Approach is estimated to cost between approximately $9 billion to $11 billion and take 15 to 20 years to implement. This approach would provide an approximate 63 percent reduction in annual flood damages compared to current conditions.

The potential for loss of life and economic damages in urban areas, which would achieve an urban level of flood protection, would be reduced substantially. Improved flood protection for small communities would also reduce the potential for loss of life and economic damages, while preserving the important resources these communities provide to surrounding rural-agricultural areas.

However, levels of protection elsewhere in the valley, particularly rural areas, would generally not improve. Consequently, this approach only partially addresses the primary goal of improving flood risk management. Figures 7-21 and 7-22 show the EAD for structure and contents, crop, and business losses for the Protect High Risk Communities Approach, compared with No Project for the Sacramento and San Joaquin river basins, respectively. Figures 7-23 and 7-24 present the change in expected damages under the Protect High Risk Communities Approach compared to No Project for the Sacramento and San Joaquin river basins respectively. For both basins, expected annual damages to structures and businesses would be reduced considerably from those incurred under No Project; however, changes to damages to crops would be minor because rural levees would not be improved under this approach.

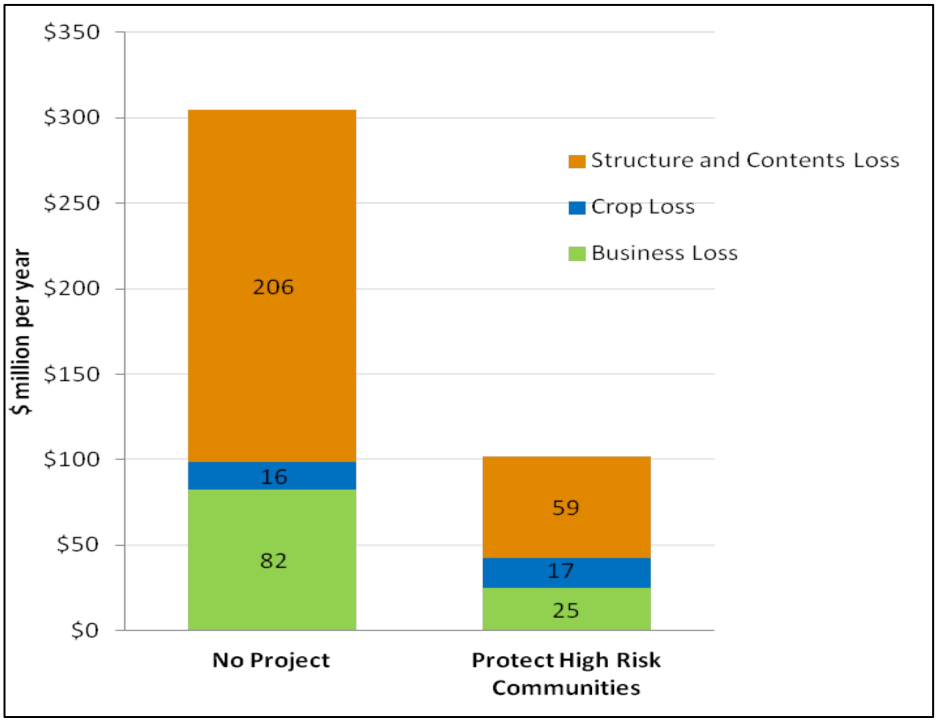


Figure 7-21. Expected Annual Damages from Flooding: Protect High Risk Communities Approach Compared to No Project for Sacramento River Basin

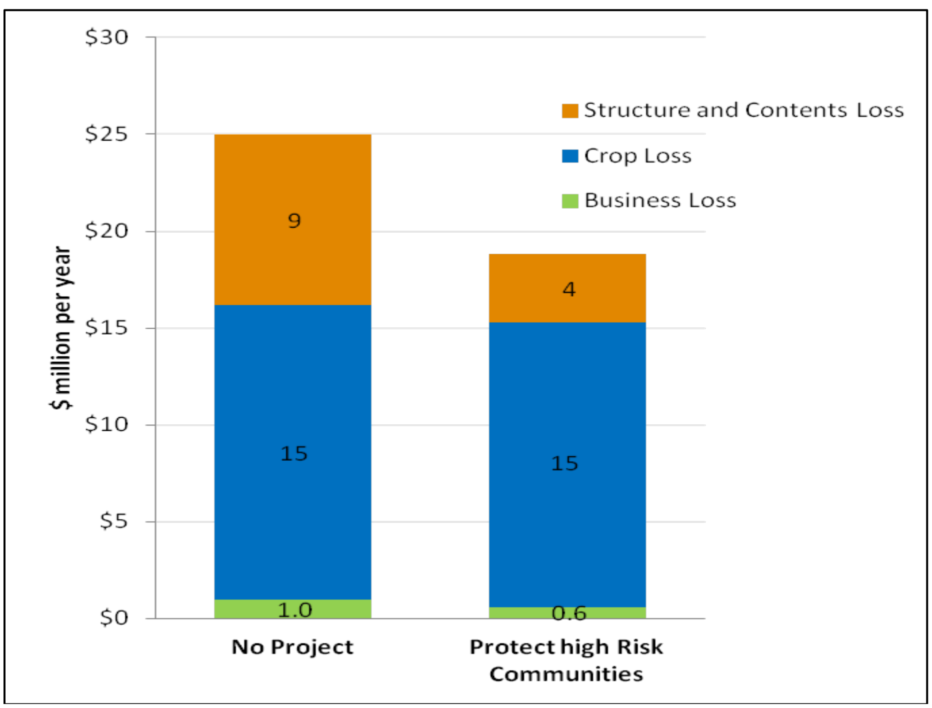


Figure 7-22. Expected Annual Damages from Flooding: Protect High Risk Communities Approach Compared to No Project for San Joaquin River Basin

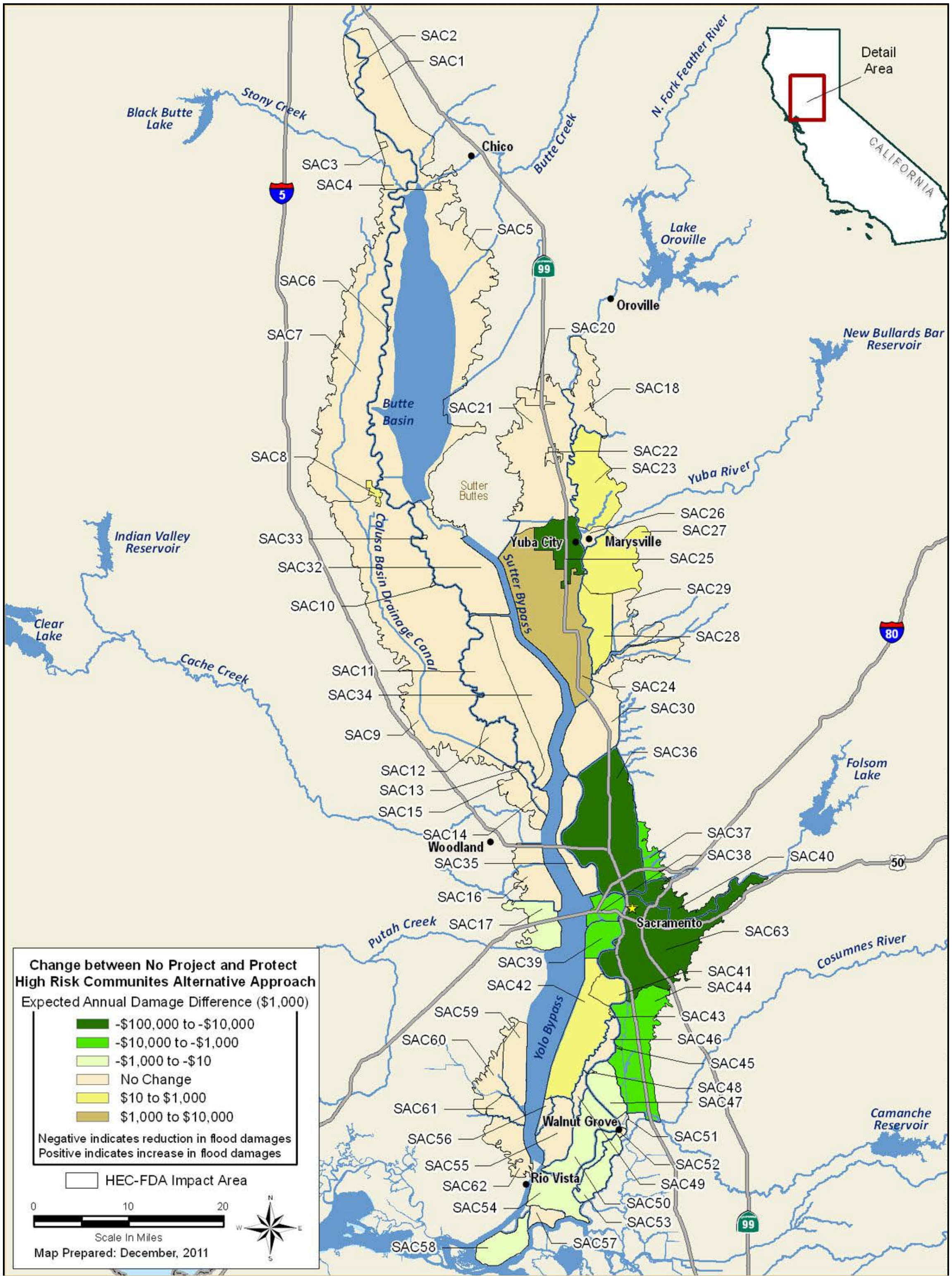


Figure 7-23. Change in Expected Annual Damages for the Sacramento River Basin Under the Protect High Risk Communities Approach Compared to No Project

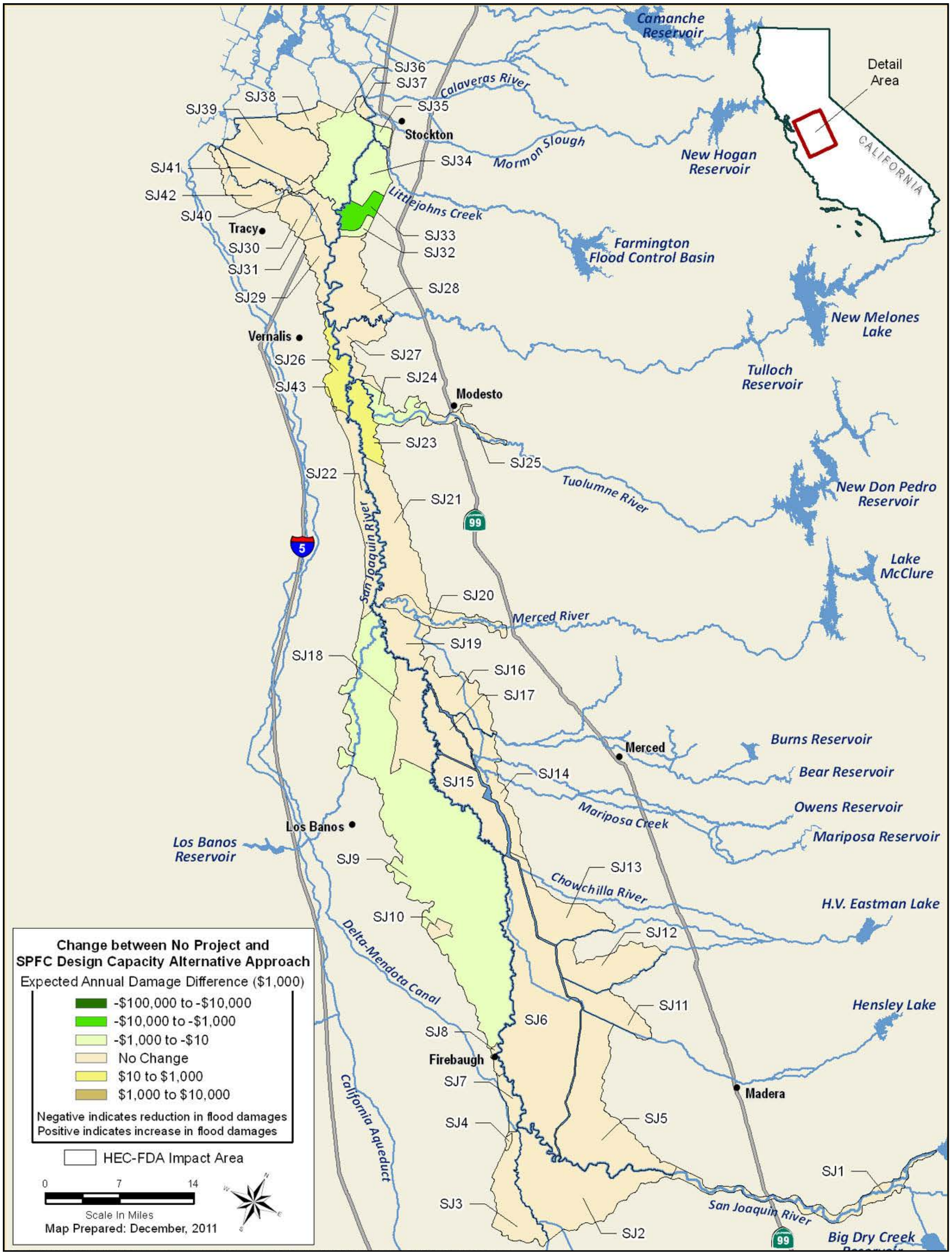


Figure 7-24. Change in Expected Annual Damages for the San Joaquin River Basin Under the Protect High Risk Communities Approach Compared to No Project

Cost Assessment

Attachment 8J: Cost Estimates provides cost estimates for the Protect High Risk Communities Approach. The costs for this approach were categorized into four flood management elements:

1. **System Improvements –** Only costs associated with F-CO/F-BO were included.

2. **Urban Improvements –** Includes 200-year LOP urban SPFC levee projects.

3. **Rural Agricultural Improvements –** Includes up to 120 miles of levee improvements to non-urban SPFC levees through the NULE Program, and new levees for small communities located within the SPFC.

4. **Residual Risk Management –** Includes features such as flood information sharing and collection and establishment of a rural post-flood recovery program because of the minimal investment in rural levee repairs could allow for more levee failures.

Table 7-12 summarizes the improvement costs for the Protect High Risk Communities Approach for the Sacramento and San Joaquin river basins.

Table 7-12. Improvement Costs for Protect High Risk Communities Approach for Sacramento and San Joaquin Basins ($ Millions)

	Sacramento River Basin			San Joaquin River Basin		
	Low		**High**	**Low**		**High**
System Improvements	$ 43	to	$ 53	$ 48	to	$ 61
Urban Improvements	$ 5,136	to	$ 6,099	$1,224	to	$ 1,440
Rural Improvements	$ 1,097	to	$ 1,316	$ 156	to	$ 188
Residual Risk Management	$ 878	to	$ 1,062	$ 479	to	$ 575
Total Costs	$ 7,154	to	$ 8,530	$ 1,907	to	$ 2,264

The estimated capital costs for improving SPFC facilities to achieve an urban LOP and for protection of small communities are significantly higher for the Sacramento River Basin because of the greater magnitude of population at risk.

7.5 Preliminary Approach Enhance Flood System Capacity

The Enhance Flood System Capacity Approach seeks opportunities to achieve multiple benefits through enhancing flood system storage and conveyance capacity. In contrast to the other preliminary approaches, which focus on improvements that can be implemented primarily within the existing footprint of the flood management system, this approach would include modifications to the existing footprint and function of the flood management system.

7.5.1 Description

This approach supports the primary goal of improving flood risk management by enhancing the capacity of the flood management system through widening floodways, reconnecting floodplains, and increasing floodwater storage. Floodwater storage would be increased through a combination of operational changes to existing reservoirs, new reservoir storage, and modified or new floodplain storage.

This approach supports the secondary goals of promoting ecosystem functions and promoting multi-benefit projects. Enhancing flood system capacity would provide opportunities to achieve multiple benefits in addition to flood risk reduction, such as environmental restoration and related water resources benefits. For example, widening floodways could contribute to the restoration of ecosystem functions while also improving floodwater conveyance; similarly, the reconnection of floodplains could restore natural floodplain processes while also providing floodwater storage.

This approach would generally increase the level of flood protection provided by the system; however, levels of protection would vary widely from location to location. Compared with previous approaches, this approach would provide the greatest opportunities for restoring native habitats (including aquatic, riparian, and floodplain habitats) and also provide opportunities to improve connectivity and ecosystem functions. In addition, it would provide opportunities to improve water supply reliability through multipurpose reservoir storage projects, conjunctively managed groundwater and surface water resources, and groundwater recharge within floodplain storage areas.

7.5.2 Approach Formulation

To formulate the Enhance Flood System Capacity Approach, a series of steps were taken to assess the effectiveness of various modifications to the system in achieving the desired goals of increasing storage and conveyance, and providing opportunities for multi-benefit integration. Table 7-13 lists the approach formulation for the Sacramento and San Joaquin river basins. Thorough an iterative process, several capacity enhancement needs were identified, and recommendations for how they should be addressed were compiled. Assessment of capacity enhancement needs and recommendations for the Sacramento and San Joaquin river reaches is summarized in Tables 7-13 and 7-14.

Table 7-13. Summary of Needs and Recommendations for Sacramento River Basin

River Reach	Capacity Enhancement Needs	Enhancement Options
Sacramento River – Redding to Colusa	Out-of-system floodwaters were observed during all analyzed flood events (0.2 to 10 percent chance event). Improve connectivity and establish riparian habitat through creation of new lands by natural deposition process while reducing O&M responsibilities.	In-place levee improvements. Setback levees in this reach are not applicable because of topography constraints. New storage and/or reservoir operation modifications are not applicable. Remove unnecessary rock sites (Chico landing area/Sacramento River split area) from the SPFC while preventing removal from negatively impacting downstream project levees or local roads and infrastructure.
Sacramento River – Colusa to Fremont	Out-of-system floodwaters were observed during less frequent flood events (0.2 to 1 percent chance event). Reduction in flood peaks through this reach is needed. Continue system O&M as is. Continue to recognize the importance of the Sutter Bypass fish passage function, and support existing habitat areas within the bypass. Some opportunities for enhancing these features may exist. There is some potential for strategic levee setbacks to reduce O&M requirements related to erosion.	Floodplain storage to reduce flood stages. Bypass expansion of Colusa, Tisdale, and/or Sutter bypasses to reduce flood stages. Weir modification to widen Fremont Weir to improve conveyance from the Sutter Bypass to Yolo Bypass. Setback levees in this reach are not effective in reducing flood stages. New storage and/or reservoir operation modifications are not applicable. New bypass in lower system to take pressure off Tisdale Weir, and continue to provide fish passage to Butte Creek with shaded riverine habitat.

Table 7-13. Summary of Needs and Recommendations for Sacramento River Basin (contd.)

River Reach	Capacity Enhancement Needs	Enhancement Options
Sutter Bypass	Out-of-system floodwaters were observed in most analyzed flood events (0.2 to 4 percent chance event). Improved conveyance is needed	Bypass expansion through levee improvements/raise, or, alternatively, in locations where physically possible, through levee setbacks.
Feather River – Oroville to Yuba City	Out-of-system floodwaters were observed in more infrequent flood events. Reduction in flood peaks through this reach is needed.	Reservoir operation changes in Lake Oroville to reduce flood stages. New bypass downstream from Lake Oroville to Butte Basin through Cherokee Canal. New storage is not applicable. Setback levee is not effective.
Feather River – Yuba City to Nicolaus	Out-of-system floodwaters were observed in all analyzed flood events (0.2 to 4 percent chance event). Some flooding in this reach is caused by backwater effects. Improved conveyance is needed.	Levee improvement/raise or, alternatively, in locations where physically possible, levee setbacks to improve reach conveyance capacity. Transitory storage to divert floodwaters of the Feather River or Sutter Bypass to reduce backwater effects on the Feather/Sacramento river junction. Construct a setback levee at the confluence of the Feather River and the Sutter Bypass to connect the river system and floodplains. However, this modification may result in unintended hydraulic effects.
Sacramento River – Fremont Weir to Rio Vista	Out-of-system floodwaters were observed during high flood events (0.2 to 2 percent chance event). Improved levee reliability and/or reduction in flood peaks through this reach are needed.	Bypass expansion of Sutter and/or Yolo bypasses to reduce flood stages in this reach. Weir modification to widen Fremont Weir to improve conveyance from the Sutter Bypass to Yolo Bypass. Setbacks not effective in this reach in achieving stage reductions. Transitory storage not effective.

Table 7-13. Summary of Needs and Recommendations for Sacramento River Basin (contd.)

River Reach	Capacity Enhancement Needs	Enhancement Options
Yolo Bypass	Out-of-system floodwaters were observed in all analyzed flood events. Improved conveyance is needed to pass peak flows through the system and reduce water surface elevations in the Sacramento River.	Bypass expansion (setting back west levee of Yolo Bypass) to increase storage/conveyance. Widen Fremont Weir.

Key:
O&M = operations and maintenance
SPFC = State Plan of Flood Control

Table 7-14. Summary of Needs and Recommendations San Joaquin River Basin

River Reach	Capacity Enhancement Needs	Enhancement Options
Fresno Slough	Out-of-system floodwaters were observed in all analyzed flood events (0.2 to 10 percent chance event). Flooding is caused by flood operations on Kings River. (Increased storage is needed.)	Floodplain transitory storage to manage floodwaters, without affecting downstream reaches of the San Joaquin River. Other actions upstream on Kings River to reduce flood release through James Bypass and Fresno Slough. Reservoir storage is not applicable. Setbacks are not effective in creating large storage.
Chowchilla, Eastside, and Mariposa Bypasses	Out-of-system floodwaters were observed in all analyzed flood events (0.2 to 10 percent chance event). Channel capacity varied throughout the bypasses, which may be affected by subsidence. Improved conveyance is needed.	Bypass conveyance capacity expansion through levee raise or, alternatively, in locations where physically possible, through levee setbacks.
San Joaquin River – Mariposa Bypass to Merced River	Improved conveyance in the bypasses would increase the volume of floodwater conveyed through this reach. Improved conveyance is needed.	Levee raises or, alternatively, in locations where physically possible, levee setbacks to increase reach conveyance capacity.

Table 7-14. Summary of Needs and Recommendations for San Joaquin River Basin (contd.)

River Reach	Capacity Enhancement Needs	Enhancement Options
San Joaquin River – Merced River to Tuolumne River	Out-of-system floodwaters were observed in all analyzed flood events (0.2 to 10 percent chance event). SPFC levees are intermittent in this reach. Floodwaters from the bypasses and the Merced River dominated the flows in this reach. Lake McClure exceeds its release objectives during a 1 percent chance flood event, with a simulated 99 TAF of inflow that is in excess of available flood storage, indicating a need for increased storage.	Floodplain transitory storage to manage floodwaters from main-stem San Joaquin and tributaries. Storage and/or reservoir operation changes on the Merced River through modifications to Lake McClure operations. Setbacks are not effective in addressing the need for large storage.
San Joaquin River – Tuolumne River to Stanislaus River	Out-of-system floodwaters were observed in all analyzed flood events (0.2 to 10 percent chance event). SPFC levees are intermittent in this reach. Floodwaters from the Tuolumne River dominate the flows in this reach. New Don Pedro Reservoir exceeded its release objectives during 2 and 1 percent chance flood events (has a simulated 86 and 224 TAF of inflow that is in excess of available flood storage, respectively), indicating a need for increased storage.	Floodplain transitory storage to manage floodwaters from main-stem San Joaquin River and tributaries. Storage and/or reservoir operational criteria changes on the Tuolumne River through modifications to New Don Pedro Reservoir. Levee setbacks, while not effective in addressing the need for large storage, may be applicable at the confluence with the Tuolumne River to address erosion problems.
San Joaquin River – Stanislaus to Stockton	Out-of-system floodwaters were observed in all analyzed flood events (0.2 to 10 percent chance event). Floodwaters from the Tuolumne River dominate flows in this reach. New Melones Reservoir is appropriately sized to accommodate up to 1 percent chance event.	Floodplain transitory storage to manage floodwaters from mainstem San Joaquin River and tributaries. Storage and/or reservoir operations modifications to New Melones Reservoir were not effective because New Melones Reservoir is already appropriately sized. Levee setbacks, while not effective in addressing the need for large storage, may be applicable at the confluence with the Stanislaus River to address erosion problems.

Key:
SPFC = State Plan of Flood Control
TAF = thousand acre-feet

7.5.3 Approach Elements

Based on the findings summarized in Tables 7-13 and 7-14, a number of storage and conveyance concepts were formulated. This approach includes modifying the existing footprint and function of the flood management system primarily to increase the overall conveyance capacity and floodwater storage, and to provide opportunities for ecosystem restoration and water resources benefits. This approach also protects high risk communities and repairs levees in place in rural-agricultural areas to achieve design flow capacity from flooding from major rivers and tributaries with SPFC facilities. This approach does not include improvements that may be needed to address interior drainage or other local sources of flooding. Also, this approach includes improvements to non-SPFC levees that protect some urban areas.

In general, flood system capacity can be increased through widening floodways and bypasses, setting back levees away from the active river channel, and increasing floodwater storage. Floodwater storage can be increased through a combination of operational changes to existing reservoirs, new reservoir storage, and modified or new floodplain storage. Widening floodways and setting back levees along some reaches of major rivers and tributaries also provides significant opportunities to restore native habitat quantity, quality, and connectivity, and to restore natural processes necessary to support healthy ecosystems.

In addition to the elements included in the prior two approaches, major elements of the Enhance Flood System Capacity Approach are shown in Figure 7-25 and include the following:

- The existing bypass system in the Sacramento River Basin, including the Sutter and Yolo bypasses and associated inflow weirs, forms the central backbone of the Sacramento River Flood Control Project, forming a corridor for conveying floodflows to the Delta. This approach would increase the capacity of the existing bypass system to enhance its efficiency and ability to convey large flood events. Initial analyses indicate that the following combination of features could effectively enhance the performance of the existing bypass system:
    - Widening the Sutter Bypass by up to 1,000 feet to increase its capacity by 50,000 cfs
    - Widening the Colusa Weir and Bypass and the Tisdale Weir and Bypass by up to 1,000 feet
    - Widening the Fremont Weir by about 1 mile, and widening portions of the Yolo Bypass to increase its capacity by 40,000 cfs

  - Widening the Sacramento Weir and Bypass by about 1,000 feet

- This approach also includes a potential new bypass to divert flows from the Feather River downstream from Oroville Dam along the alignment of Cherokee Canal into Butte Basin. Initial analyses indicate that a bypass with a capacity of 32,000 cfs could reduce peak flood elevations along the Feather River and help convey floodflows into the existing bypass system.

- In the lower portion of the San Joaquin River Basin, this approach includes a new bypass to divert flows from the San Joaquin River into the south Delta. Preliminary analyses indicate that a new bypass at Paradise Cut, or in its vicinity, with a capacity of about 4,000 cfs could effectively reduce peak flood stage along the San Joaquin River in the Stockton Metropolitan Area.

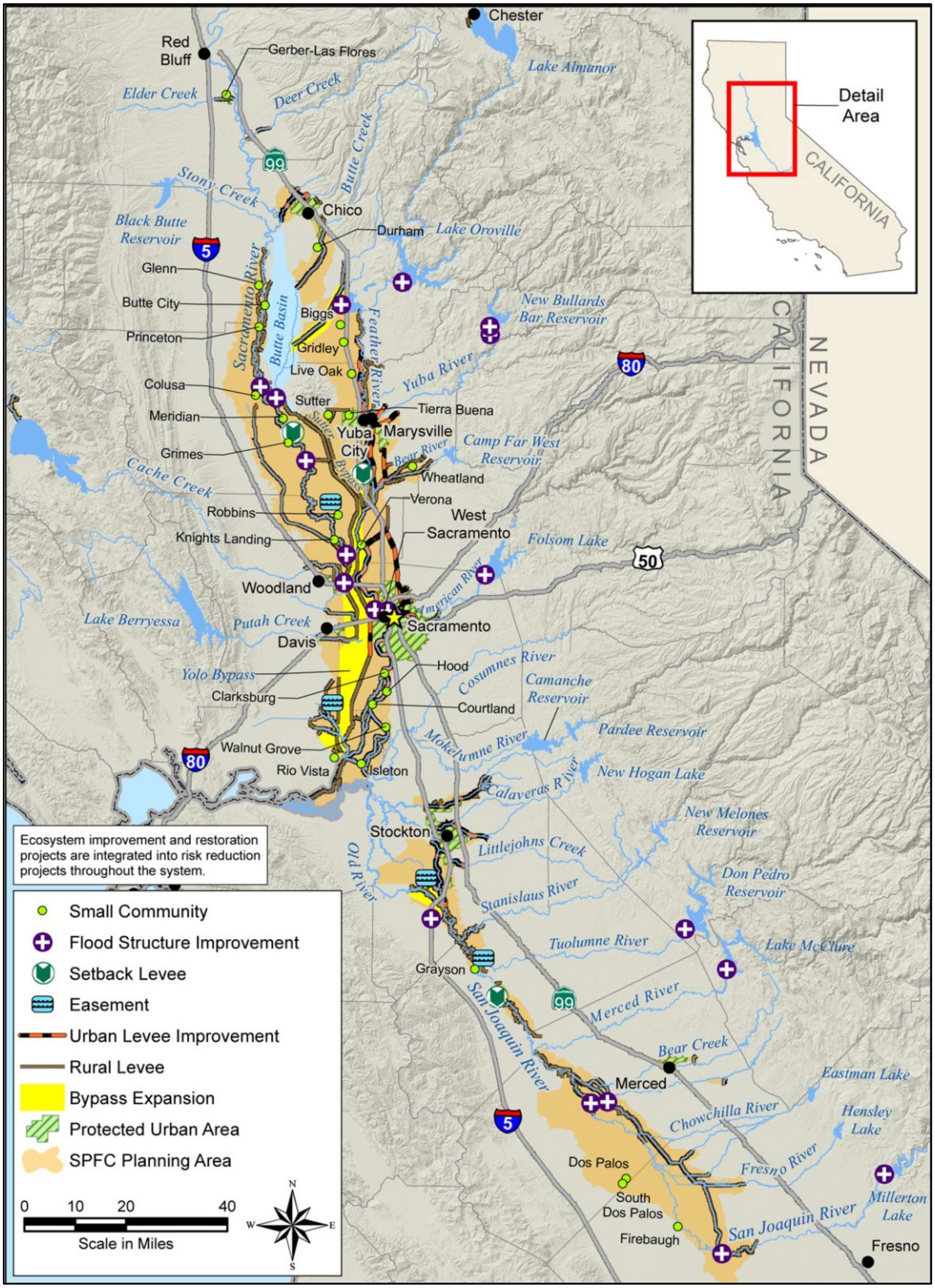
- This approach includes floodway widening along smaller sections of some rivers by setting back SPFC levees as follows:

  - Along the right bank of the Feather River (below the Bear River confluence) to allow opportunities for ecosystem restoration and to provide continuity with Sutter Bypass

  - Along intermittent sections of the Sacramento River upstream from the Tisdale Weir to provide a more continuous corridor for environmental restoration and to address levee conditions

  - Along the San Joaquin River between the Merced and Stanislaus rivers

- This approach includes modification to the reservoir release schedule and flood storage allocation at Oroville Dam and Reservoir (equivalent to an additional 200,000 acre-feet of flood storage), and coordinated operation with Bullards Bar Reservoir, to reduce flood stages on the Feather River during a 200-year (0.5 percent annual chance) flood event. Also, in the San Joaquin River Basin, the State would partner with interested reservoir operators to increase the flood storage allocation at New Don Pedro, Friant, and New Exchequer dams by about 400,000 acre-feet to effectively manage the 100-year (1 percent annual chance) flood event at these reservoirs. These features help manage the timing and magnitude of peak floodflows before they enter the Sacramento and San Joaquin rivers.



Key: SPFC = State Plan of Flood Control

Figure 7-25. Improvements Included in Enhance Flood System Capacity Approach

- This approach includes approximately 200,000 acre-feet of transitory storage in the floodplains of the Sacramento River Basin and approximately 100,000 acre-feet of transitory storage in the floodplains of the San Joaquin River Basin. Floodplain storage effectively works with bypass and floodway expansion to attenuate flood peaks and provide opportunities for conservation of agricultural lands and native floodplain habitats.

7.5.4 Approach Assessment

Based on an initial assessment, the Enhance Flood System Capacity Approach is estimated to cost between approximately $32 billion to $41 billion and would take 35 to 40 years to implement. This approach would provide an approximate 80 percent reduction in annual flood damages compared to current conditions.

This investment would expand system storage and conveyance capacity, resulting in reduced peak flood stages throughout the system. This would, in turn, result in increased levels of flood protection throughout the system, although levels would continue to vary from location to location. Some urban areas would achieve an urban level of flood protection, or higher, through the combination of conveyance and storage improvements, while others would not.

Flood Stage Assessment

This approach would provide opportunities to address chronic erosion, geomorphic conditions, and levee foundation conditions that make O&M of the current system costly and unsustainable. Hence, the approach would significantly address the supporting goal of improving O&M.

This investment would expand the system storage and conveyance capacity resulting in reduced peak flood stages throughout the system (see Figure 7-26). In the Sacramento River Basin, reduction in stage would result from expansion of the Sutter and Yolo bypasses as well as from widening the Fremont and Sacramento weirs. By improving the levees, diverting flows to bypasses, and widening the channel in key locations, more water would be allowed to flow through the system at reduced stage.

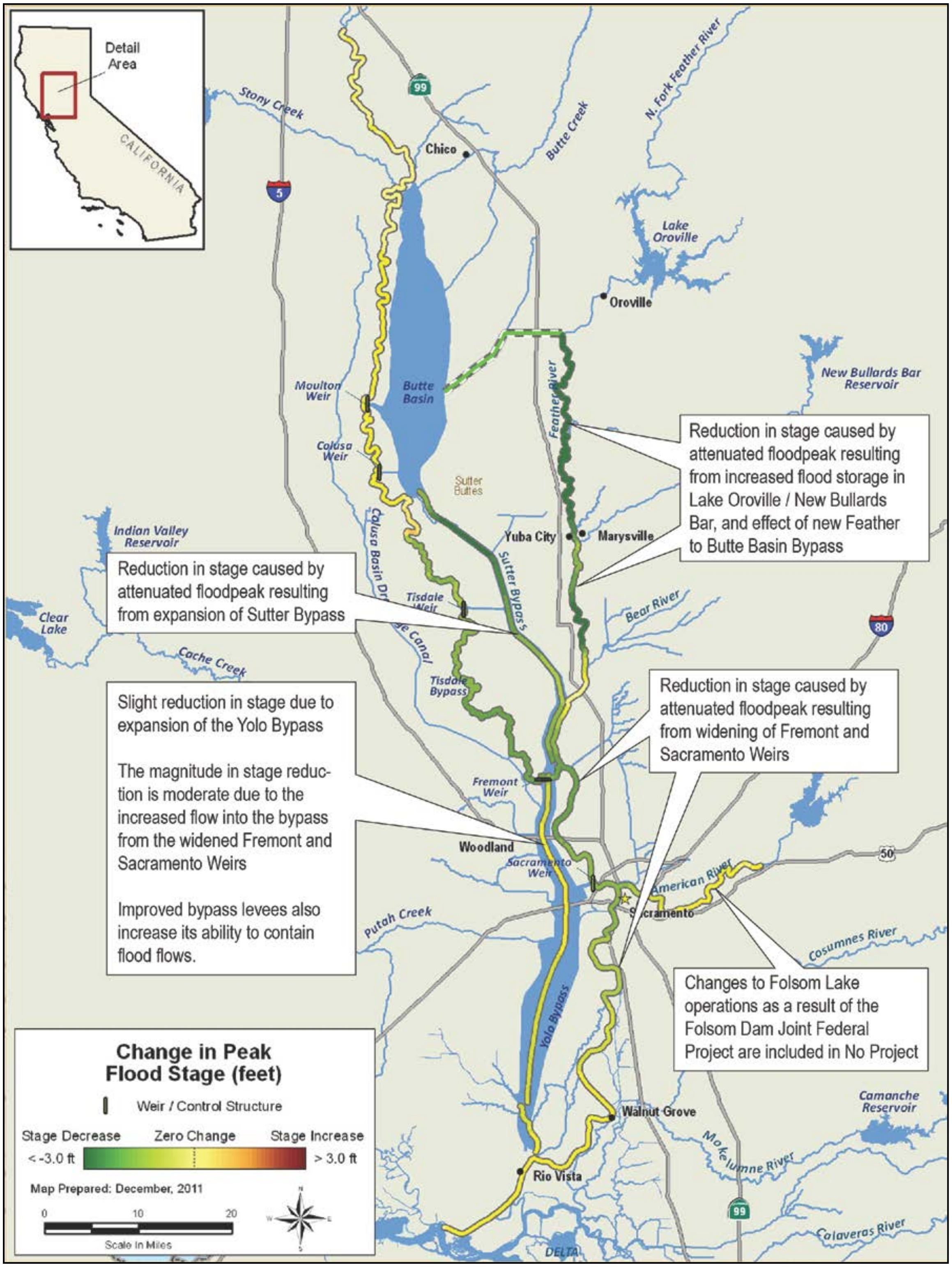


Figure 7-26. Change in Peak Flood Stage for Enhance Flood System Capacity Approach Compared to No Project in Sacramento River Basin (100-year Event)

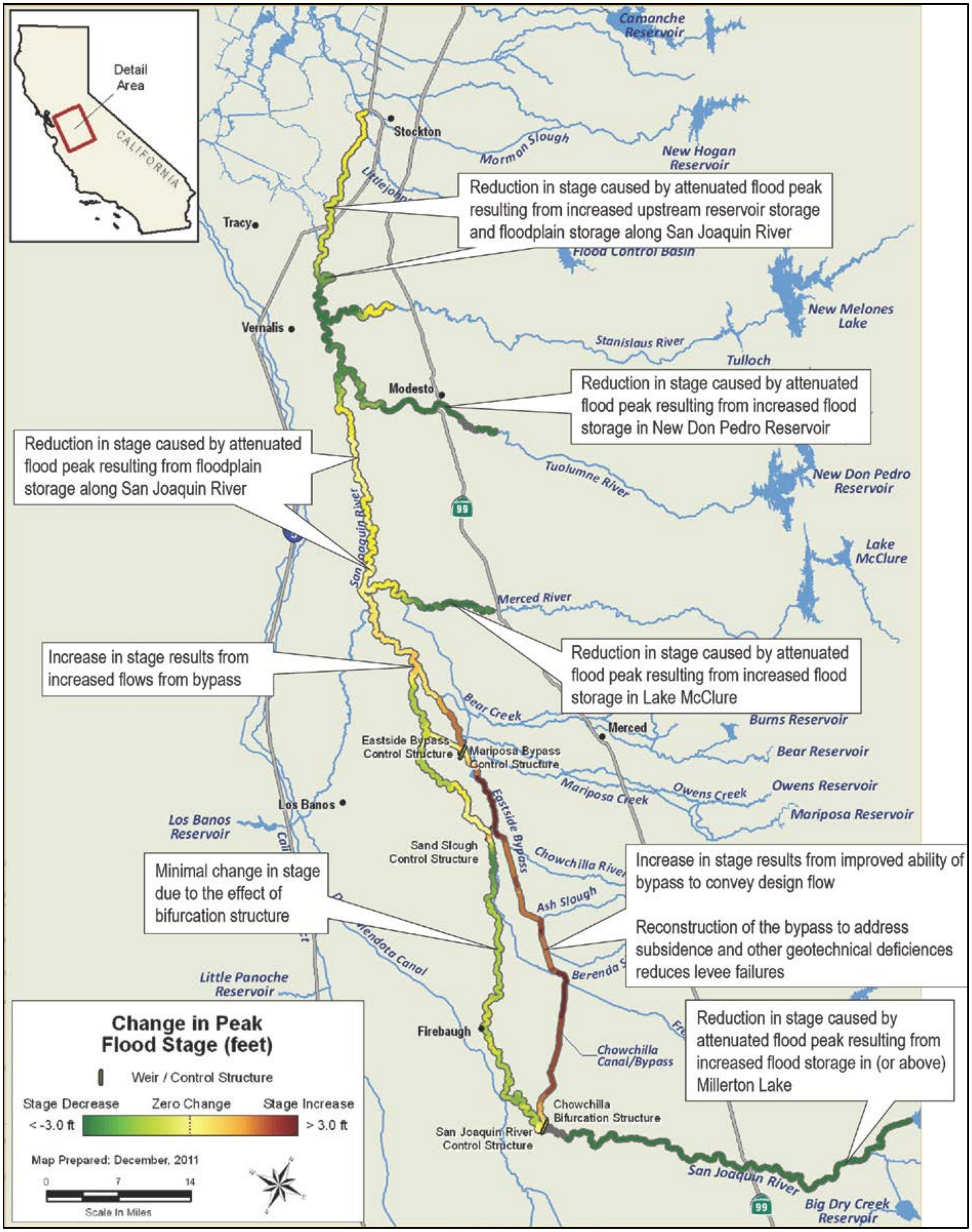


Figure 7-27. Change in Peak Flood Stage for Enhance Flood System Capacity Approach Compared to No Project in San Joaquin River Basin (100-year Event)

In the San Joaquin River Basin, stage reductions due to increase flood storage in reservoirs and floodplain easements would be partly offset by an increase in stage as a result of repairing and strengthening the Chowchilla/Eastside/Mariposa bypasses levee system (see Figure 7-27).

Overall, the Enhance Flood System Capacity Approach would result in increased levels of flood protection throughout the system, although levels would continue to vary from location to location.

Environmental Assessment

This approach would provide opportunities to restore native habitats (including aquatic, riparian, and floodplain habitats) and improve the quality and connectivity of environmental resources within the flood management system. It would also provide opportunities to improve (1) water supply reliability through multipurpose reservoir storage projects, (2) conjunctive management of groundwater and surface water resources, and (3) groundwater recharge within floodplain storage areas. Accordingly, it would fully address the supporting goals of promoting ecosystem functions and multi-benefit projects.

Economics Assessment

Economic damages would be reduced to various degrees throughout the system. Accordingly, this approach would address the primary goal of improving flood risk management, although at a high cost.

Figures 7-28 and 7-29 show the EAD for structure and contents, crop and business losses for the Enhance Flood System Capacity Approach compared with No Project for the Sacramento and San Joaquin river basins, respectively. Figures 7-30 and 7-31 provide geographic representations of the changes between the Enhance Flood System Capacity Approach and No Project for the Sacramento and San Joaquin river basins respectively. For both basins, expected annual damages to structures and businesses will be reduced considerably from those incurred under No Project.

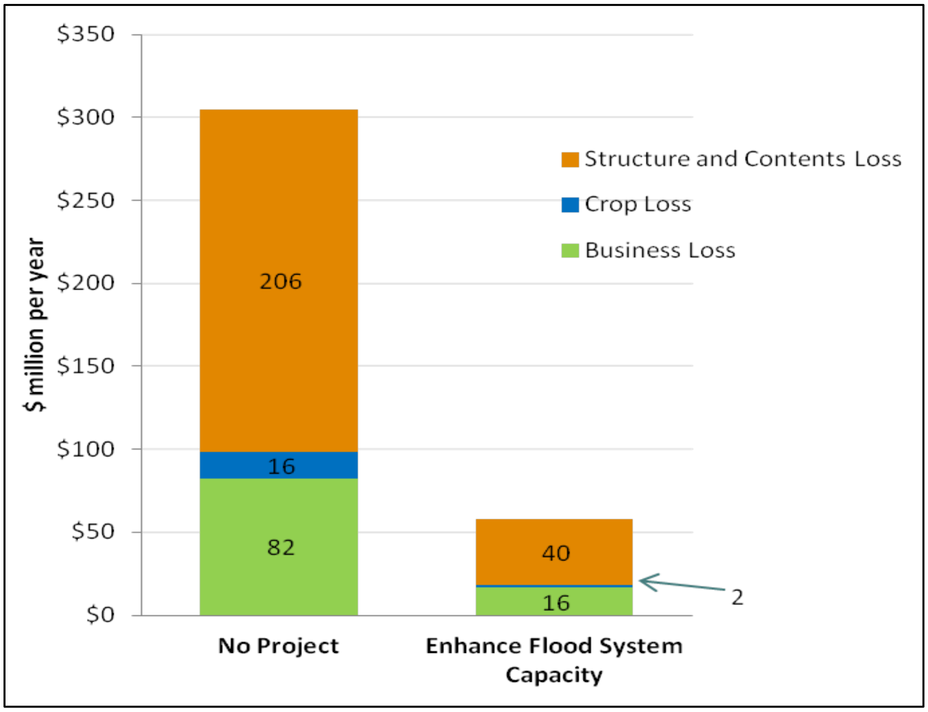


Figure 7-28. Expected Annual Damages from Flooding: Enhance Flood System Capacity Approach Compared to No Project for Sacramento River Basin

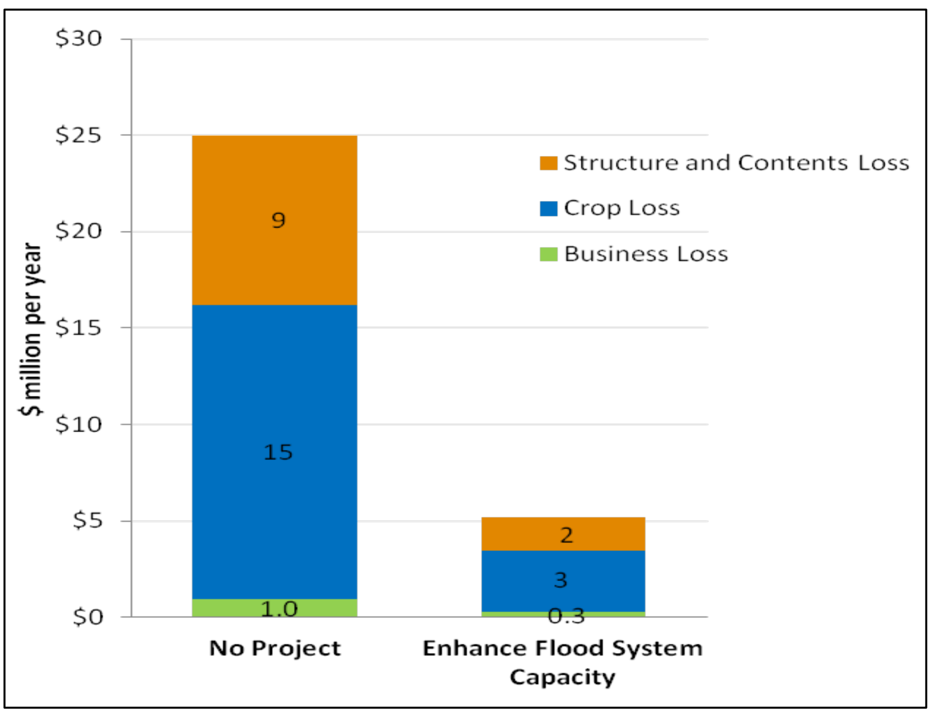


Figure 7-29. Expected Annual Damages from Flooding: Enhance Flood System Capacity Approach Compared to No Project for San Joaquin River Basin

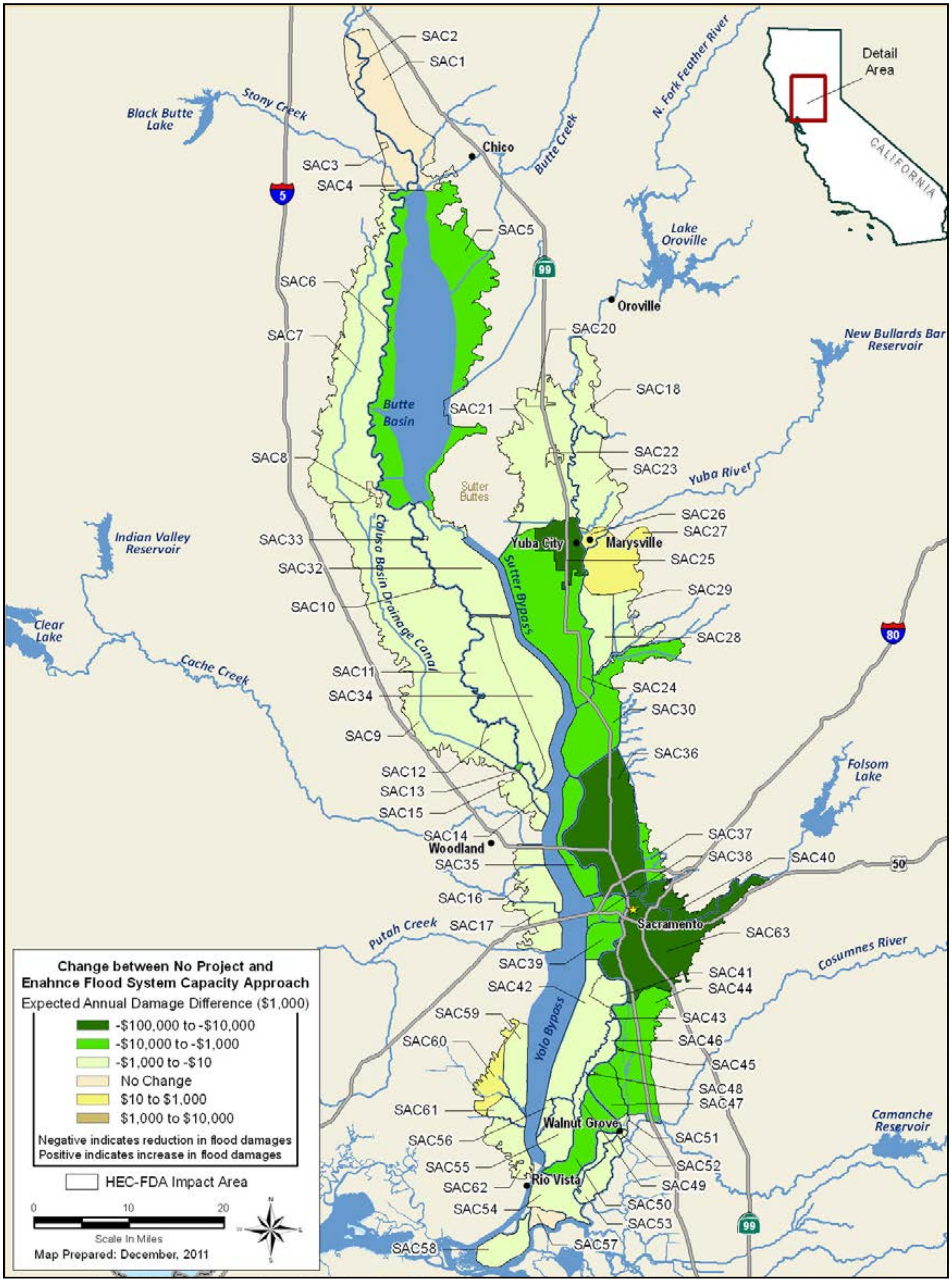


Figure 7-30. Change in Expected Annual Damages for the Sacramento River Basin Under the Enhance Flood System Capacity Approach Compared to No Project

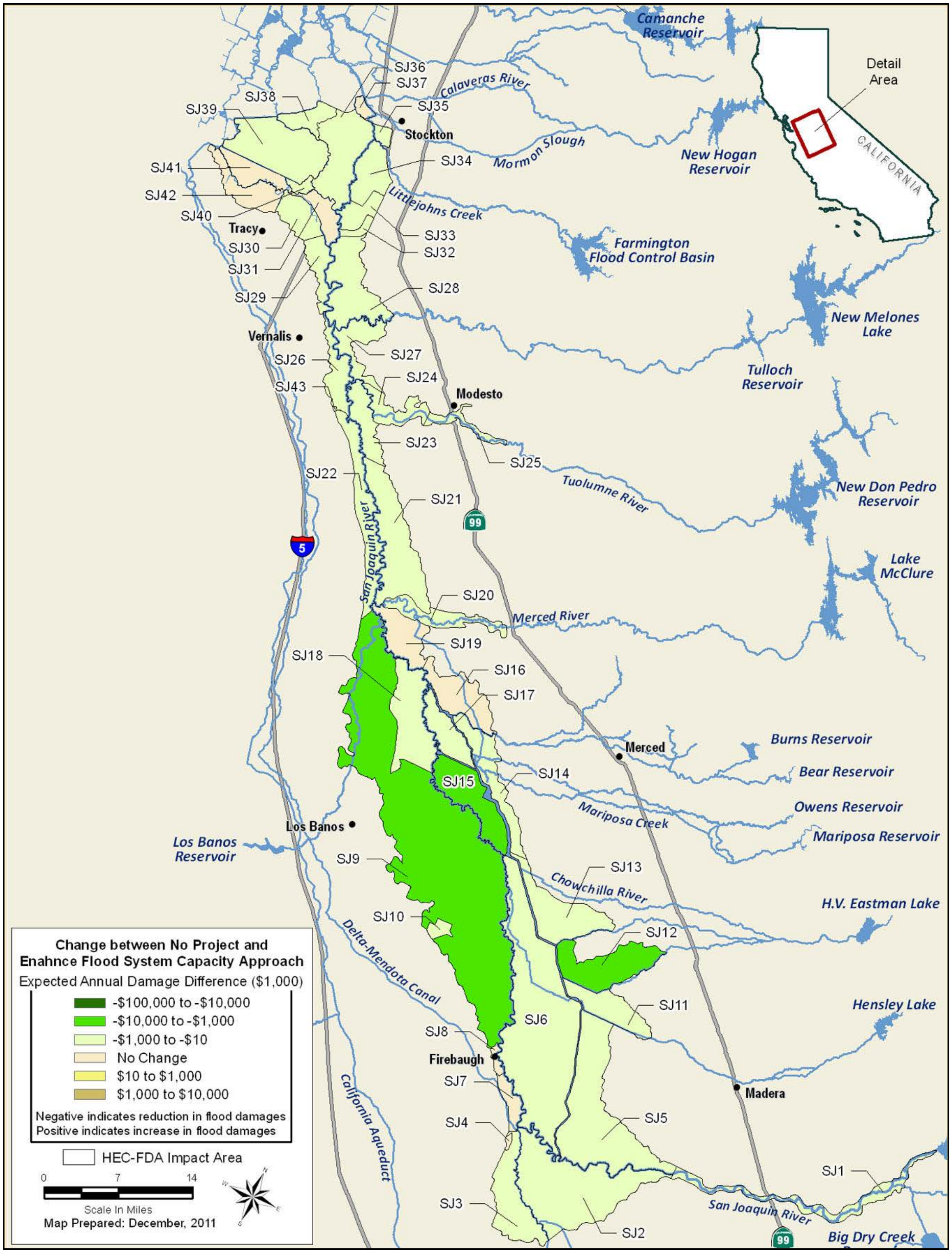


Figure 7-31. Change in Expected Annual Damages for the San Joaquin River Basin Under the Enhance Flood System Capacity Approach Compared to No Project

Cost Assessment

The Draft 2012 CVFPP – Cost Estimating Methodology Memorandum (GEI Consultants, 2011) provides cost estimates for the Enhance Flood System Capacity Approach. The costs for this approach were categorized into four flood management elements:

1. **System Improvements –** This is a significant element of the Enhance Flood System Capacity Approach. In addition to costs associated with F-CO/F-BO, this approach also includes costs for bypass expansion and improvements, fish passage improvements, and increased flood storage in foothill reservoirs and on floodplains.

2. **Urban Improvements –** Includes 200-year LOP urban SPFC levee projects.

3. **Rural Agricultural Improvements –** Includes improvements to non-urban SPFC levees through the NULE Program, and new levees for small communities located within the SPFC.

4. **Residual Risk Management –** This is a minor part of the Enhance Flood System Capacity Approach since the need is expected to be less than other approaches because of the significant investment in physical flood system improvements.

Table 7-15 summarizes the improvement costs for the Enhance Flood System Capacity Approach for the Sacramento and San Joaquin river basins.

Table 7-15. Improvement Costs for the Protect High Risk Communities Approach for the Sacramento and San Joaquin Basins ($ Millions)

	Sacramento River Basin			San Joaquin River Basin		
	Low		High	Low		High
System Improvements	$ 5,394	to	$6,846	$ 2,216	to	$ 4,043
Urban Improvements	$ 4,704	to	$ 5,091	$ 792	to	$ 434
Rural Improvements	$ 14,425	to	$ 18,366	$ 3,663	to	$ 4,709
Residual Risk Management	$ 442	to	$ 536	$ 211	to	$ 232
Total Costs	$ 24,965	to	$ 30,839	$ 6,882	to	$ 9,446

7.5.5 Residual Risk Management

Even with the realization of major physical improvements to the flood management system, the risk of flooding can never be completely eliminated. Unanticipated facility failures or extreme flood events may cause flooding. This remaining flood threat is called “residual risk.”

DWR manages residual risk through programs governed by DWR’s existing organization for FloodSAFE implementation. These programs are responsible for specialized work in the following areas:

- Flood emergency response
- Flood O&M
- Floodplain risk management

Areas protected by levees that undergo major improvements will generally require lower levels of residual risk management compared with levees that are not improved.

In addition to the major physical elements shown above, each approach would require different levels of ongoing annual management of residual risk. Emergency response, flood system O&M, and floodplain risk management depend on the configuration and reliability of the physical features included in the system. Table 7-16 shows residual risk management for the three preliminary approaches. The columns on the right show the residual risk management actions included for each preliminary approach. In some cases, the actions would be implemented with a small, medium, or large level of effort. Additional discussion of residual risk is included in Section 8.11.

7.6 Evaluation and Comparison of Accomplishments

To illustrate the potential trade-offs among benefits, costs, and other factors relevant to formulation of the SSIA, the three preliminary approaches were compared according to their effectiveness in contributing to the 2012 CVFPP goals and other performance measures.

Table 7-16. Residual Risk Management

Flood Management Element	Project Location or Required Components	Achieve SPFC Design Flow Capacity	Protect High Risk Communities	Enhance Flood System Capacity
Enhanced Flood Emergency Response	All-Weather Roads on Levee Crowns	(included in rural levee repairs)	(No rural levee repairs)	(included in rural levee repairs)
	Flood Information Collection and Sharing	YES (small)	YES (large)	YES (small)
	Local Flood Emergency Response Planning	YES	YES	YES
	Forecasting and Notification		YES	
	Rural Post-Flood Recovery Assistance Program		YES (large)	
Enhanced Operations and Maintenance	Identify and Repair After Event Erosion	YES (small)	YES (large)	YES (small)
	Develop and Implement Enhanced O&M Programs and Regional O&M Organizations	YES	YES	YES
	Sacramento Channel and Levee Management, and Bank Protection	YES	YES	YES
Floodplain Management	Raising and Waterproofing Structures and Building Berms	YES*	YES*	YES*
	Purchasing and Relocating Homes in Floodplains	YES*	YES*	YES*
	Land-Use and Floodplain Management	YES	YES	YES

* Ongoing FEMA programs, implementation based on available funding and conformance with federal criteria

Key:
O&M = operations and maintenance
SPFC = State Plan of Flood Control

7.6.1 System Performance Indicators

Several system performance indicators can demonstrate how well each of the approaches meets the primary goal of the 2012 CVFPP, improving flood risk management. These system performance indicators include the following:

- **Life Risk –** Life risk is described as the long-term annual number of lives potentially lost in an identified area, considering a given climate and land-use condition, with a specified plan of flood protection in place.

- **Expected Annual Damages –**The key output of HEC-FDA is the EAD, which is defined as the average or mean of all possible values of damages determined by Monte Carlo sampling.

- **Level of Protection –** LOP is defined as the amount of flood protection able to withstand flooding for AEP.

- **Changes in Peak Flow –** The effectiveness of the flood management system can be measured by how much the peak flood flow is reduced.

Other system performance indicators measure how each of the approaches meet the supporting goals of the CVFPP. These secondary performance indicators include the following:

- **Changes in O&M –** Improvements in O&M can be measured by the cost or frequency to complete routine O&M.

- **Ecosystem Function –** Promotion of ecosystem functions can be measured by the restoration of key physical processes, restoration of habitats, and number of native species.

- **Institutional Support –** Improvement of institutional support can be measured by the amount of funding available for flood management projects or the number of projects that are completed.

- **Multi-Benefit Projects –** Promotion of multi-benefit projects can also be measured by the amount of funding available or the number of projects completed.

7.6.2 Primary Goal Indicators

This section summarizes the results for each of the primary goal indicators.

Life Risk

The consequence of flood inundation may be measured in terms of direct and/or indirect economic costs, loss of life, environmental impacts, or other specified measure of flood effects. In the analysis described herein, the consequence of flood risk is represented in terms of potential loss of life. Life risk, as described in the 2012 CVFPP, is the long-term average annual number of lives potentially lost in an identified area, considering a given climate and land-use condition, with a specified plan of flood protection in place.

A life risk calculation, as an indicator or representation of flood risk, was developed based on the following:

- Population exposed to inundation before a warning is given

- Types and efficiencies of warning systems

- Exposed population after a warning is given
- Potential loss of life due to inundation

Table 7-17 summarizes the estimated life risk values for the Sacramento and San Joaquin river basins, for No Project and the three 2012 CVFPP preliminary approaches. These values are the expected annual statistics computed by HEC-FDA. Details on how life risk values were calculated can be found in Attachment 8G: Life Risk Analysis.

Table 7-17. Summary of Life Risk Values: Sacramento and San Joaquin River Basins

Study Approaches	Sacramento River Basin	San Joaquin River Basin)	Stockton Area	Total
No Project	58.6	4.1	1.4	64.1
Achieve SPFC Design Flow Capacity	56.0	4.0	0.2	60.2
Protect High Risk Communities	31.6	3.9	0.2	35.6
Enhance Flood System Capacity	23.2	2.0	0.2	25.4

Key:
SPFC = State Plan of Flood Control

The general trend shows that all three approaches would reduce potential lives lost relative to No Project, with the highest potential reduction realized through the Enhance Flood System Capacity Approach.

Economic Damages

Economic damages from a flood event indicate the performance of the flood management system. Figures 7-32 and 7-33 present the annual structure, crop and business losses for the Sacramento and San Joaquin river basins for No Project and each of the three preliminary approaches. Economic damages are shown in millions of dollars per year.

In the Sacramento River Basin, the general trend shows that all three approaches reduce annual damages and business losses relative to No Project, with the highest potential economic benefits realized through the Enhance Flood System Capacity Approach (Figure 7-32).

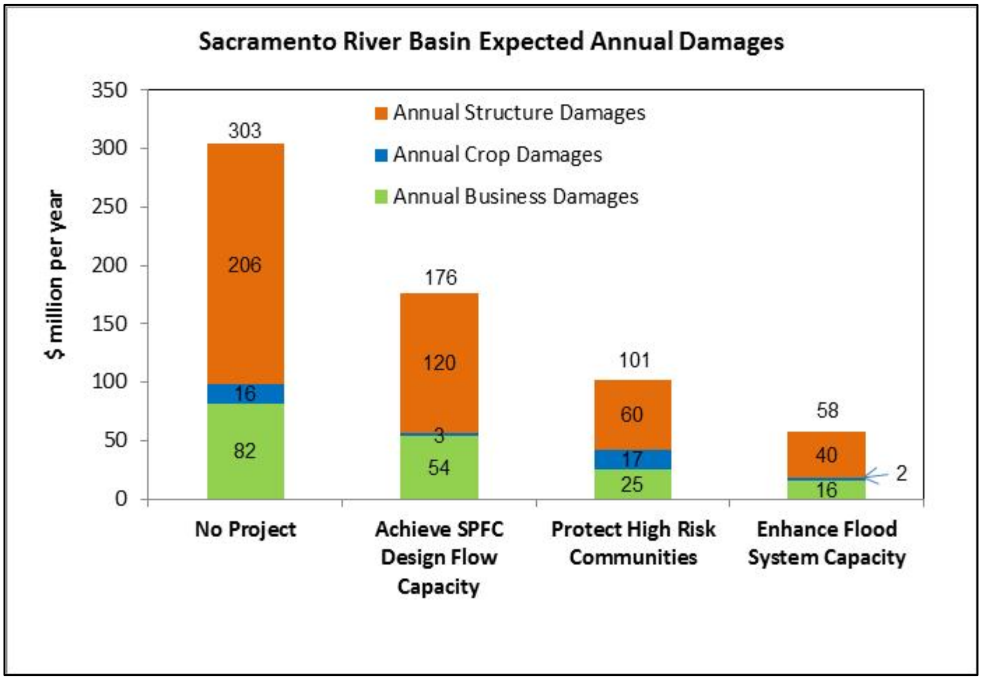


Figure 7-32. Summary of Potential Annual Direct Impacts of Flooding in the Sacramento River Basin

In the San Joaquin River Basin, the general trend shows that all three approaches reduce annual structure damages relative to No Project (Figure 7-33). Annual business losses remain unchanged from No Project by any of the preliminary approaches. Annual crop damages are reduced by the Achieve SPFC Design Flow capacity and the Enhance Flood System Capacity approaches; however, the Protect High Risk Communities Approach does not show a reduction in annual crop damages. This is because although cities and towns are protected under this approach, agricultural lands do not receive an increased LOP.

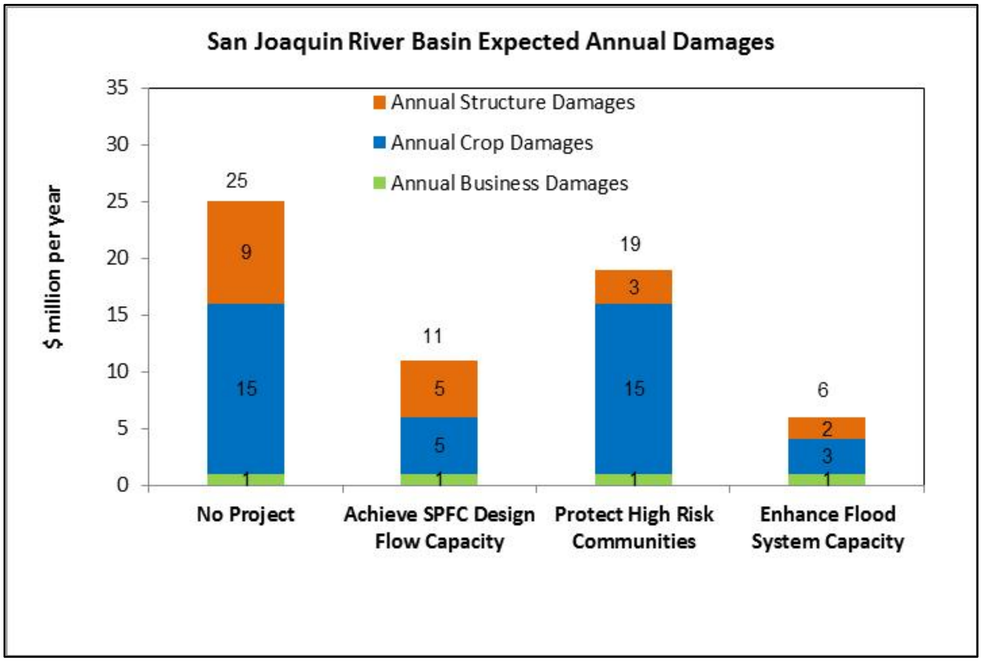


Figure 7-33. Summary of Potential Annual Direct Impacts of Flooding in the San Joaquin River Basin

Level of Protection

The 2012 CVFPP has a goal for urban areas to achieve an LOP against a 0.5 percent AEP flood event (200-year LOP). The goal for rural areas is to achieve an LOP against a 1 percent AEP flood event (100-year LOP). Figures 7-34 and 7-35 show the populations in the Sacramento and San Joaquin river basins and the LOP afforded to them under each approach. All of the preliminary approaches showed an increase in the percentage of populations that are protected from the 0.5 or 1 percent AEP flood versus No Project with the greatest LOP for the greatest population occurring under the Protect High Risk Communities Approach.

Change in Peak Flow

The three preliminary approaches result in different peak flows and stages. Hydrologic and hydraulic modeling for the three preliminary approaches provided estimates of peak flow and stage compared to No Project at key SPFC locations[1]. Figure 7-36 shows peak 100-year floodflows at several of these locations within the Sacramento River Basin for No Project and the three preliminary approaches. The figure also shows the corresponding peak stage change for each preliminary approach compared to current conditions.

[1] A separate hydraulic analysis would be required to assess hydraulic impacts.

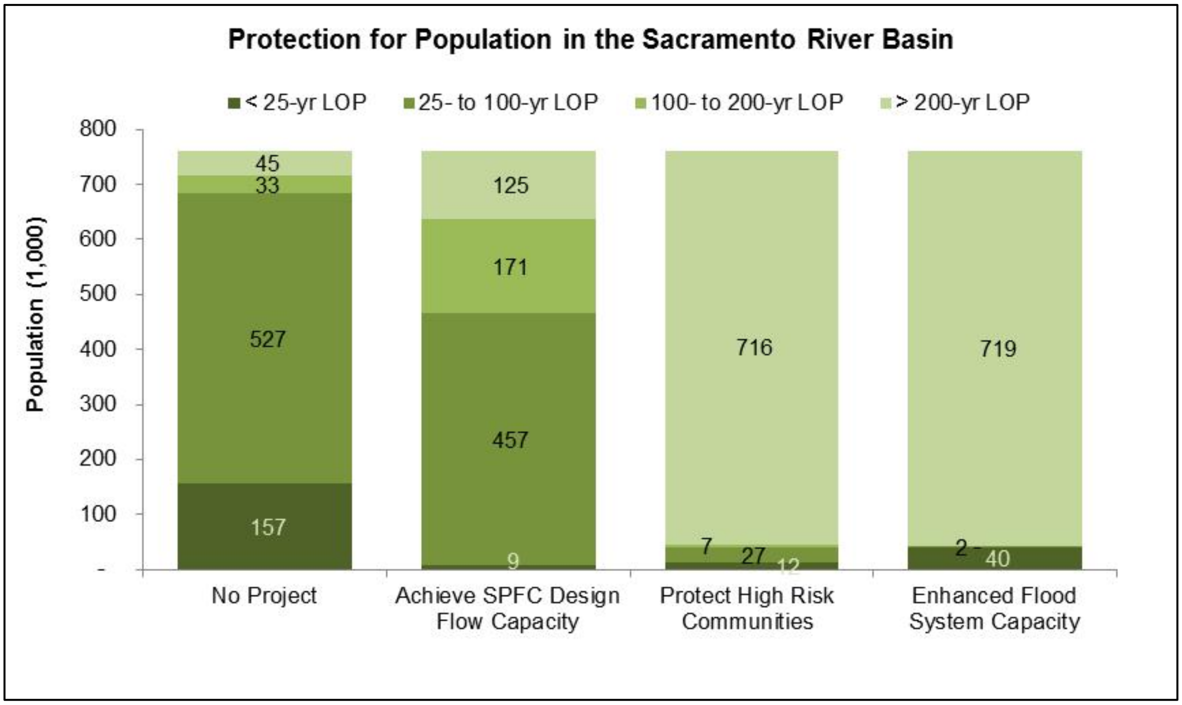


Figure 7-34. Protection for Population in Sacramento River Basin

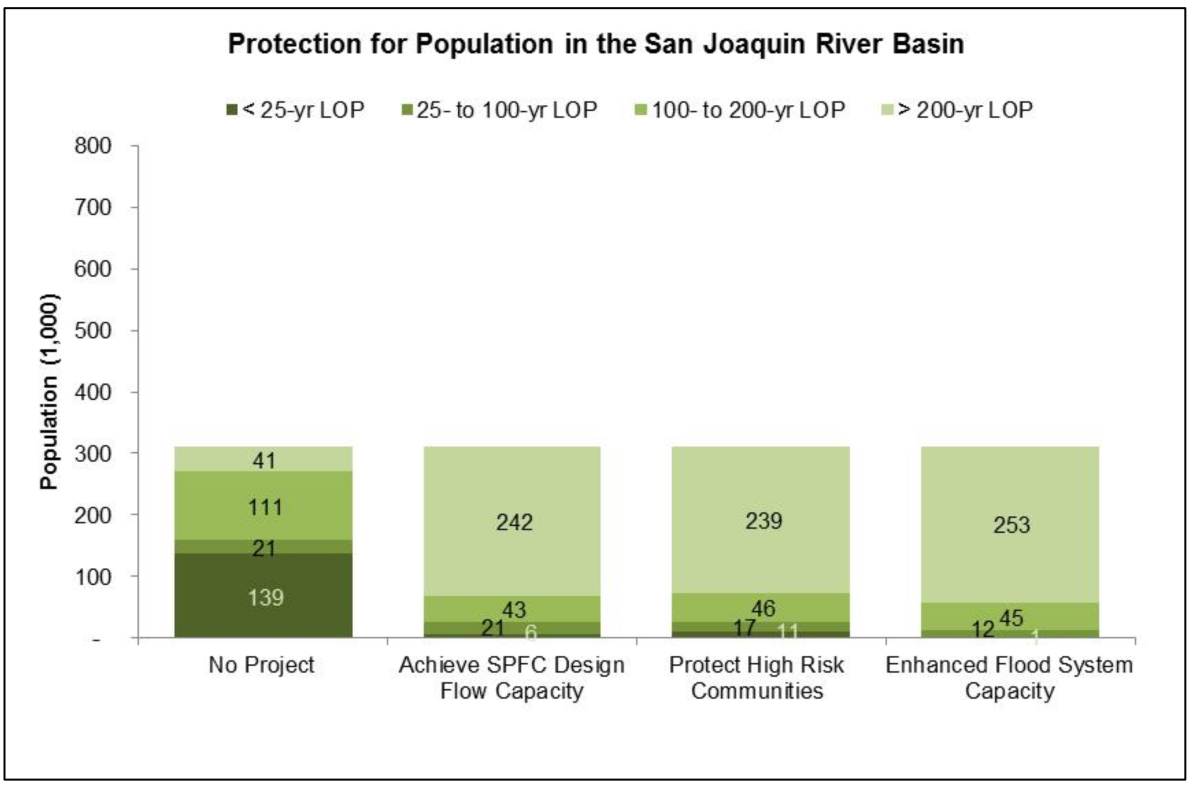


Figure 7-35. Protection for Population in San Joaquin River Basin

Figure 7-37 shows peak 100-year floodflows at several of these locations within the San Joaquin River Basin for current conditions and the three preliminary approaches. The figure also shows the corresponding peak stage for each preliminary approach compared to current conditions.

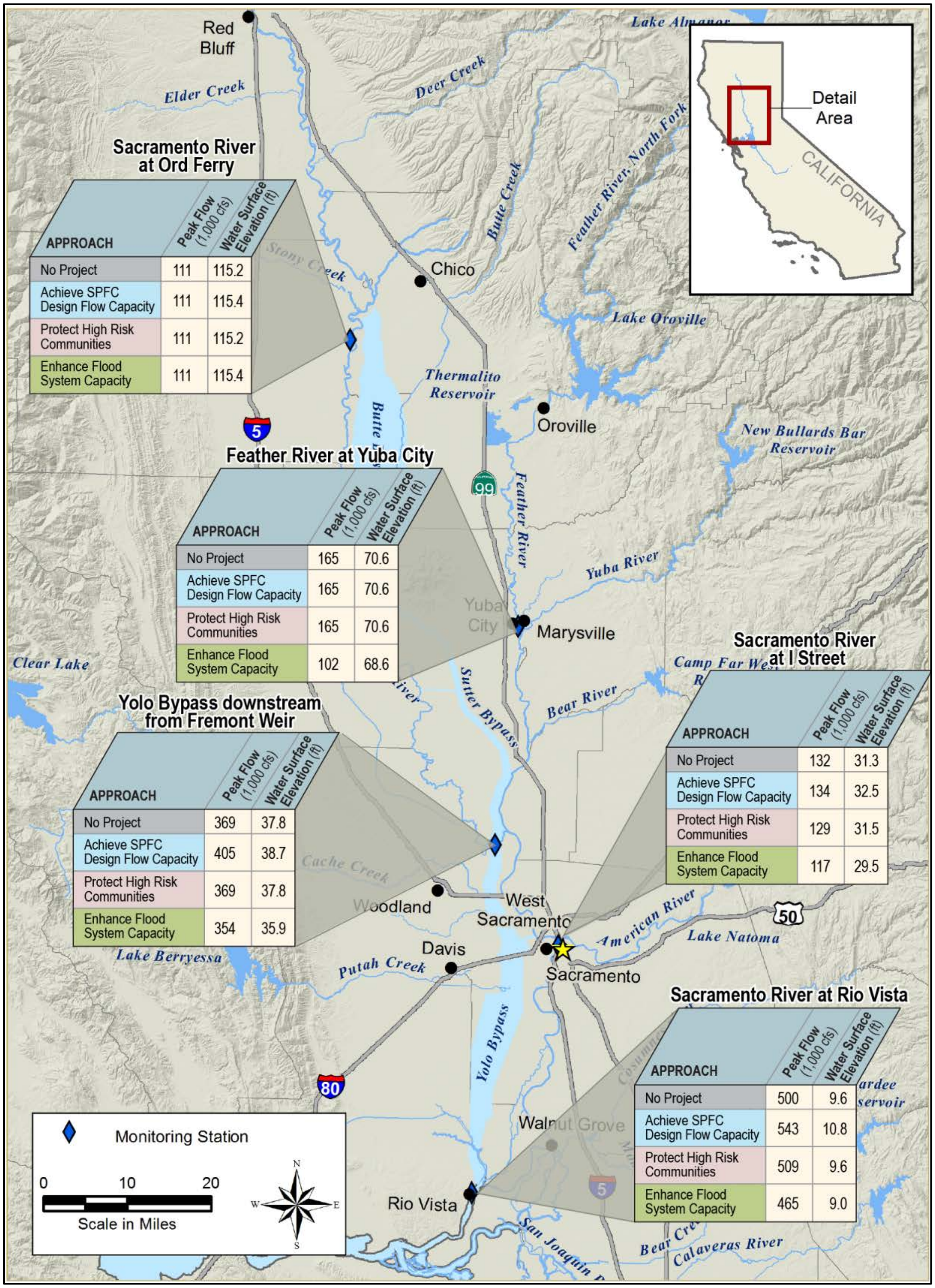
In general, the Achieve SPFC Design Flow Capacity Approach would result in higher river stages than for No Project because levee rehabilitation would result in more water being passed. The Protect High Risk Communities Approach would result in relatively little stage change compared with existing conditions because levee improvements would be focused in small areas and much of the levee system would remain in its current condition. The Enhance Flood System Capacity Approach generally would provide for lower flood stages, except in the upper San Joaquin River Basin bypass, since flood peaks would be lowered by storage, and bypasses would provide wider flow areas that reduce stages.

7.6.3 Supporting Goal Indicators

As stated above, four other system performance indicators were used to measure how each of the approaches would meet the secondary goals of the 2012 CVFPP. These secondary goal indicators include improvements in O&M, promotion of ecosystem functions, improvement of institutional support, and promotion of multi-benefit projects. Improvements in O&M can be measured by the cost to complete or frequency of completing routine O&M. In addition to routine O&M, the need and cost to complete nonroutine O&M can be an indicator of how well the flood management system is performing. Promotion of ecosystem functions can be measured by the restoration of key physical processes, restoration of habitats, and number of native species. The number of fish passage opportunities can also be an indicator of ecosystem functions in the flood management system. Improvement of institutional support can be measured by the amount of funding available for flood management projects or the number of projects that are completed. Promotion of multi-benefit projects can also be measured by the amount of funding available or the number of projects completed. To complete multi-benefit projects, a qualitative assessment of opportunities to integrate water quality, groundwater recharge, recreation, power, and other benefits should be completed for flood management planning projects.

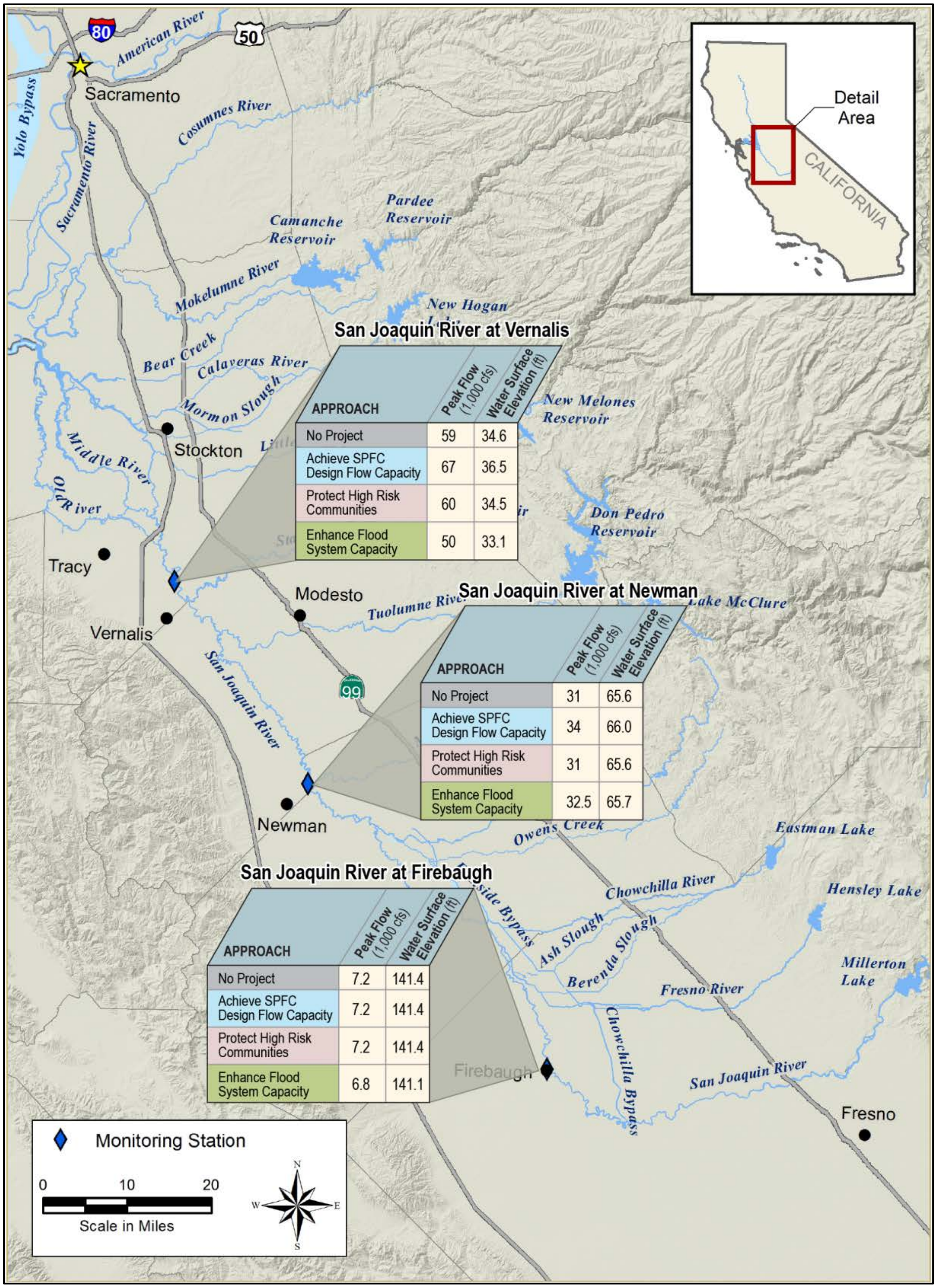
Multi-Benefit Projects

To complete multi-benefit projects, a qualitative assessment of opportunities to integrate water quality, groundwater recharge, recreation, power, and other benefits should be completed for flood management planning projects.



Note: Location of peak flow and water surface elevation estimates for 100-Year storm event at selected monitoring locations in the Sacramento River Basin.
Key: cfs = cubic feet per second ft = feet SPFC = State Plan of Flood Control

Figure 7-36. Simulated Peak Flow and Stage Changes for Sacramento River Basin for 100-Year Storm Events



San Joaquin River at Vernalis

APPROACH	Peak Flow (1,000 cfs)	Water Surface Elevation (ft)
No Project	59	34.6
Achieve SPFC Design Flow Capacity	67	36.5
Protect High Risk Communities	60	34.5
Enhance Flood System Capacity	50	33.1

San Joaquin River at Newman

APPROACH	Peak Flow (1,000 cfs)	Water Surface Elevation (ft)
No Project	31	65.6
Achieve SPFC Design Flow Capacity	34	66.0
Protect High Risk Communities	31	65.6
Enhance Flood System Capacity	32.5	65.7

San Joaquin River at Firebaugh

APPROACH	Peak Flow (1,000 cfs)	Water Surface Elevation (ft)
No Project	7.2	141.4
Achieve SPFC Design Flow Capacity	7.2	141.4
Protect High Risk Communities	7.2	141.4
Enhance Flood System Capacity	6.8	141.1

Note: Location of peak flow and water surface elevation estimates for 100-Year storm event at selected monitoring locations in the San Joaquin River Basin
Key: cfs = cubic feet per second ft = feet SPFC = State Plan of Flood Control

Figure 7-37. Simulated Peak Flow and Stage Changes for San Joaquin River Basin for 100-Year Storm Events

7.6.4 Other Indicators

Other considerations for the different approaches include downstream effects. Improvements to the flood management system would cause fewer system failures, which could increase downstream Delta inflows.

The flood management system in the Delta manages flows from the Sacramento and San Joaquin watersheds, tributaries, and tides from the San Francisco and San Pablo bays. Water management facilities in the Delta include levees around the developed islands, pumping plants, control gates, port facilities, gages used in flood and water quality forecasting, and diversion and inlet structures. Summary findings for the Delta Model results for No Project are as described in Section 3 of Attachment 8D: Estuary Channel Evaluations. Results are shown in two formats:

1. Stage-frequency curves for 15 locations in the Delta to show the peak water stage of each of six storm events.

2. Peak volume of water inside inundated Delta islands.

Comparing these No Project results to results for each of the three preliminary approaches can be used to compare the downstream effects for each approach. Flows to the Delta can affect levee stress and levee failures.

7.6.5 Contributions to the 2012 CVFPP Goals

Table 7-18 compares the relative contributions of the preliminary approaches to the 2012 CVFPP primary goal of improving flood risk management. Contributions to the primary goal are described in terms of level of flood protection, public safety, and economic damages.

Table 7-19 compares the relative contributions of the preliminary approaches to the 2012 CVFPP supporting goals of Improve Operations and Maintenance, Promote Ecosystem Functions, and Promote Multi-Benefit Projects. Table 7-19 also assesses the relative completeness of the preliminary approaches described as the ability to meet the various objectives described in the authorizing legislation.

Sustainability

Table 7-20 compares the sustainability aspects of the three preliminary approaches. Sustainability relates to the overall financial, environmental, social, and climate change adaptability aspects of the flood management system under a given approach.

Table 7-18. Relative Comparison of Preliminary Approach Contributions to Central Valley Flood Protection Plan Primary Goal

Metric	Existing System (No Project)	Preliminary Approaches		
		Achieve SPFC Design Flow Capacity	Protect High Risk Communities	Enhance Flood System Capacity
Contributions to Primary Goal – Improve Flood Risk Management				
Level of Flood Protection	**Varies throughout system** • Most urban areas do not have urban level of flood protection • Protection to rural-agricultural areas and small communities varies widely	**Varies throughout system** • Substantial improvement in rural-agricultural areas and partial improvement in urban areas • SPFC facilities reliably pass design flow capacities • Levels of flood protection associated with SPFC design flow capacities vary throughout the system	**High in urban areas and small communities, varies elsewhere** • Urban areas achieve 200-year flood protection • Small communities achieve 100-year flood protection	**Overall higher protection, but varies throughout system** • Urban areas achieve 200-year flood protection • Small communities achieve 100-year flood protection • Overall increased levels of flood protection throughout system
Public Safety (focused on population at risk)	**Varies throughout system** • Public safety threat is high for many communities, particularly those in deep floodplains • **79% of population with less than 100-year protection**	**Some improvement** • Improvement in urban areas • Improvement in some small communities protected by SPFC facilities • **46% of population with less than 100-year protection**	**Highest improvement** • Substantial improvement in urban areas • Improvement in small communities • **6% of population with less than 100-year protection**	**Improvement varies** • Improvement in urban areas • Improvement in small communities and rural-agricultural areas • **5% of population with less than 100-year protection**
Economic Damages[1]	**Very high potential for damages** • Economic damages, particularly in urban areas, are very high • $329 million /year in EAD	**Reduction in rural-agricultural area damages** • Substantial reduction throughout rural areas; some reduction in urban areas • 43% reduction in total EAD	**Reduction in urban and small community damages** • Substantial reduction due to focus on protecting urban areas and small communities • 63% reduction in total EAD	**Reduction in urban and rural-agricultural area damages** • Substantial reduction due to increased storage and conveyance • 80% reduction in total EAD

Note:

[1] Structure and content values used parcel data from the 2010 June ParcelQuest with an October 2010 price index. Parcel data were updated based on information (including depreciation, construction quality, construction class, occupancy type) in reconnaissance-level field surveys collected from summer 2010 to summer 2011.

Crop data acreages were from the May 2010 DWR GIS land-use datasheet. Crop damage unit costs were originated from the USACE Comprehensive Study (2002) and were adjusted to an October 2010 price index. EAD include, structure and content, crop, and business income loss.

Key:
CVFPP = Central Valley Flood Protection Plan
DWR = California Department of Water Resources
EAD = expected annual damages
GIS = Geographic Information System
SPFC = State Plan of Flood Control

Table 7-19. Comparison of Preliminary Approach Contributions to Central Valley Flood Protection Plan Supporting Goals and Completeness

Goal/Metric	Existing System (No Project)	Preliminary Approaches		
		Achieve SPFC Design Flow Capacity	**Protect High Risk Communities**	**Enhance Flood System Capacity**
Contributions to Supporting Goals				
Improve Operations and Maintenance	**Ongoing and long-term O&M requirements remain very high**	**Initial decrease in O&M costs, but remain high long term** • SPFC reconstruction will initially decrease O&M requirements • Long-term O&M costs would remain high because of potential conflicts with natural geomorphic process	**Increase in long-term O&M requirements** • Potential cost increase due to the construction of approximately 120 miles of new levees to protect small communities	**Decrease in long-term O&M requirements** • Decrease in long-term costs due to modifications that make the system more compatible with natural geomorphic processes and facilitate vegetation management and removal of facilities
Promote Ecosystem Functions and Environmental Restoration	**Limited opportunities for ecosystem restoration** • Native habitat may be integrated into SPFC facility repair projects, primarily through mitigation	**Limited opportunities for ecosystem restoration** • Limited opportunities to integrate ecosystem restoration into in-place repairs to SPFC facilities	**Limited opportunities for ecosystem restoration** • Limited opportunities to integrate restoration into in-place repairs in urban areas, and new facilities protecting small communities	**Substantial opportunities for ecosystem restoration** • Floodplain expansion improves ecosystem functions, fish passage, and the quantity, quality, and diversity of habitats
Promote Multi-Benefit Projects	**Limited opportunities for multi-benefit project** • Limited opportunities to integrate other benefits into repairs to SPFC facilities	**Limited opportunities for multi-benefit project** • Limited opportunities to integrate other benefits into repairs to SPFC facilities	**Limited opportunities for multi-benefit project** • Limited opportunities to integrate other benefits into repairs, improvements, and new levees	**Enhanced opportunities for multi-benefit project** • Increased opportunities to integrate water quality, groundwater recharge, recreation, power, and other benefits
Completeness (ability to meet legislative objectives)				
Ability to Meet Objectives in Flood Legislation	**Do not meet** • Varied level of protection throughout the system and high potential for public safety and economic damages	**Partially meets** • Limited contributions to environmental and water supply objectives; does not achieve high level of urban flood protection	**Partially meets** • Limited contributions to environmental and water supply objectives	**Mostly meets** • Contributes to all objectives, but at highest cost and with substantial impacts to existing land uses (potentially low acceptability)

Key:
CVFPP = Central Valley Flood Protection Plan
O&M = operations and maintenance
SPFC = State Plan of Flood Control

Table 7-20. Relative Comparison of Preliminary Approach Sustainability

Metric	Existing System (No Project)	Preliminary Approaches		
		Achieve SPFC Design Flow Capacity	Protect High Risk Communities	Enhance Flood System Capacity
Sustainability (financial, environmental, and social)				
Social	• Significant risk to public safety and economic consequences of flooding	• Chance for redirected growth outside floodplain from where currently planned due to extensive levee improvements in non-urban areas • Some land-use impacts due to acquisition/easements to accommodate SPFC reconstruction	• Some potential to encourage new development in floodplains within and adjacent to urban and small community improvements	• Considerable impacts to existing land uses due to floodway expansion • Some potential to encourage new development in floodplains due to improved level of flood protection
Climate Change Adaptability	• Low system resiliency (i.e., ability to adapt to climate change)	• Does not improve flood system resiliency	• Does not improve flood system resiliency	• Improves flood system resiliency by enhancing storage and conveyance

Key:
SPFC = State Plan of Flood Control

7.6.6 Costs and Time to Implement

The estimated costs and time to implement the three preliminary approaches are shown in Table 7-21.

Table 7-21. Estimated Cost of Approaches

Preliminary Approach	Low Cost ($ billion)		High Cost ($ billion)	Implementation (Years)
Achieve SPFC Design Flow Capacity	19	to	23	30 – 35
Protect High Risk Communities	9	to	11	15 – 20
Enhance Flood System Capacity	32	to	41	35 – 40

Key:
SPFC = State Plan of Flood Control

Cost estimates in the table are for initial costs to implement physical on-the-ground improvements over 25 years to manage the residual risk for each approach. These estimates are based on 2011 dollars and will differ in the future. Since the approaches are not complete alternatives, the cost estimates are likely low, but suitable for comparison of the approaches. In addition, actual implementation costs would likely be higher than the estimates because of inflation and the length of time needed to implement the work. The cost estimates allow for planning studies, design, permitting, and project mitigation. The estimates also include costs for ecosystem mitigation for the first two preliminary approaches. For the Enhance Flood System Capacity Approach, the goal is for ecosystem restoration and enhancements to provide for overall habitat improvement, thereby eliminating the need to mitigate for most ecosystem impacts. However, depending on the timing of improvements and implementation, some ecosystem mitigation may be required.

The estimates of time to implement are based on experience with past flood projects, but with assumptions of more efficient execution of planning and design, engaged federal and local partners, streamlined permitting, and timely funding. In the past, many flood protection projects have remained in the feasibility study phase for a decade or more. Large complicated projects have often taken several decades to progress from initial concept to completion. Maintaining focus to complete projects in a timely manner is often difficult, especially given changing commitments from State, federal, and local partners over long periods of time.

7.6.7 Preliminary Approach Performance

Considering evaluation information available for the preliminary approaches, including information shown in this section, DWR prepared a qualitative comparison to show the broad differences in potential performance of the approaches. Figure 7-38 shows estimated relative performance for each preliminary approach. For example, an open circle indicates the lowest performance and a full circle indicates the highest performance.

PERFORMANCE CATEGORY	ACHIEVE SPFC DESIGN FLOW CAPACITY	PROTECT HIGH RISK COMMUNITIES	ENHANCE FLOOD SYSTEM CAPACITY
Flood Risk Reduction Benefit	◑	◕	●
Level of Flood Protection	◔	◑	●
Life Safety	◔	◕	◕
Reduction in Economic Damages	◑	◕	◕
Regional Economics	◑	◕	●
Integration and Sustainability	○	◔	●
Promote Ecosystem Functions	○	○	●
Promote Multi-Benefit Projects	○	◔	●
Sustainable Land Uses	○	◔	●
Cost	$$$	$$	$$$
Capital Costs	$$$	$	$$$$
Operations & Maintenance	$$	$$$$	$

BENEFIT KEY

- ○ Low
- ◔ Low-Moderate
- ◑ Moderate
- ◕ Moderate-High
- ● High

COST KEY

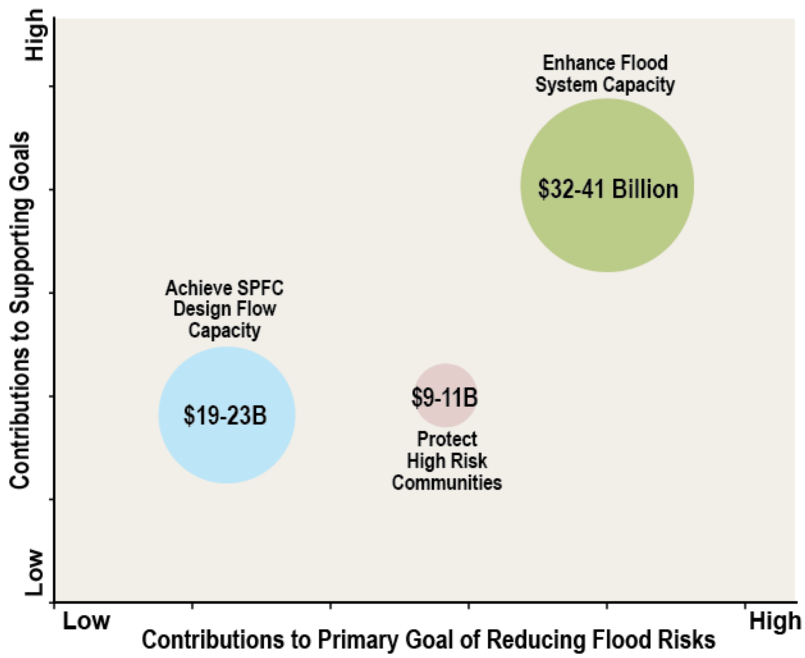
- $ Low-Moderate
- $$ Moderate
- $$$ Moderate-High
- $$$$ High

Key: SPFC = State Plan of Flood Control

Figure 7-38. Performance Comparison for Preliminary Approaches

Another view of the relative performance of the three preliminary approaches is shown in Figure 7-39. The figure shows estimated performance in terms of secondary benefits against performance for the primary goal of improving flood risk management. For example, the Achieve SPFC Design Flow Capacity Approach and the Protect High Risk

Communities Approach perform similarly for secondary benefits, but the Protect High Risk Communities Approach performs better for improving flood risk management. The figure also plots the size of the approaches (circles) relative to their estimated costs.



Key: B = billion SPFC = State Plan of Flood Control

Figure 7-39. Relative Cost and Performance of Three Preliminary Approaches

7.7 Summary of Findings

Based on relative comparisons of the three preliminary approaches, no single approach contributes substantially to the five 2012 CVFPP goals. However, each approach highlights opportunities to achieve the goals in different ways and to different degrees. The Enhance Flood System Capacity Approach meets most of the legislative objectives and scores highest on sustainability; however, it has a substantially higher capital cost, compared to the other approaches. The Protect High Risk Communities Approach is the least costly approach, and would result in substantial reduction in flood risks to urban areas and small communities.

Examining the performance of preliminary approaches highlights the need to develop a State flood management strategy that combines the strengths of each of the three preliminary approaches into a single approach – the SSIA. The three preliminary approaches presented above contributed to 2012 CVFPP goals to differing degrees. For example, the Achieve SPFC Design Flow Approach would provide protection for rural-agricultural areas, with less emphasis on an urban level of flood protection and ecosystem benefits. The Protect High Risk Communities Approach would achieve 200-year urban protection and associated life safety benefits, but does not contribute to improving rural-agricultural flood risk management. The Enhance Flood System Capacity Approach would provide multiple benefits, but at a high cost. Various elements from each of the three approaches have been chosen and combined to formulate the SSIA.

Following are additional observations on performance of the preliminary approaches that contributed to formulation of the SSIA.

Achieve SPFC Design Flow Capacity – Improving the existing flood management system to meet current engineering criteria within its existing footprint:

- Is very expensive considering that it primarily addresses the Improve Flood Risk Management goal and does little for supporting goals, especially for promoting multi-benefit projects
- Level of flood protection is significantly improved throughout the system, but is spatially highly variable
- Would increase the population receiving at least a 100-year (1% annual chance) level of flood protection from about 21 percent to about 54 percent compared with existing conditions
- May initially improve operations and maintenance conditions, but long-term benefits are questionable
- Does little to improve ecosystem functions
- May increase flood risks (residential development) in rural-agricultural areas
- Would create significant increases in downstream flood stages over existing conditions by reducing the chance of levee failures upstream
- Would reduce potential flood damages by about 43 percent compared to existing conditions
- Need for residual risk management would be reduced from existing conditions

Protect High Risk Communities – Improving levees in urban areas and small communities:

- Protects, with the least investment, the majority of the population
- Does little to address supporting goals of improving operations and maintenance and promoting ecosystem functions
- Would do little to contribute to adaptive flood management
- Urban areas would achieve 200-year (0.5% annual chance) level of flood protection
- Small communities within the area protected by facilities of the SPFC would achieve 100-year (1% annual chance) of flood protection
- Would increase the population receiving at least a 100-year (1% annual chance) level of flood protection from about 21 percent to about 94 percent compared with existing conditions
- Level of flood protection for rural-agricultural areas would remain unchanged
- Relatively few increases in downstream flood stages from upstream improvements
- Would reduce potential flood damages by about 63 percent compared to existing conditions
- Need for residual risk management would be the highest among the preliminary approaches

Enhance Flood System Capacity – Improving urban, small communities, and rural-agricultural levees along with expanded flow capacity:

- Is by far the most expensive approach
- Significantly meets all CVFPP Goals
- Urban areas would likely exceed 200-year (0.5% annual chance) level of flood protection
- Many small communities would likely exceed 100-year (1% annual chance) level of flood protection

- Most areas, including rural-agricultural areas, would benefit from lower flood stages, improved levee conditions, and improved levees constructed for bypass expansion
- Would reduce potential flood damages by about 80 percent compared to existing conditions
- Would increase the population receiving at least a 100-year (1% annual chance) level of flood protection from about 21 percent to about 95 percent compared with existing conditions
- Need for residual risk management would be the lowest among the preliminary approaches
- Includes significant ecosystem features and multipurpose projects

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8.0 State Systemwide Investment Approach

This section provides an overview of existing and future systemwide conditions in the SPFC and Systemwide Planning Areas. More detailed information can be found in the plan-related and reference documents listed in Section 2.4.

The State Systemwide Investment Approach (SSIA) reflects the State's strategy for modernizing the SPFC to address current challenges and affordably meet the 2012 CVFPP Goals described in Section 5. The preliminary approaches, described in Section 7, suggested a broad range of physical and institutional flood damage reduction actions to improve public safety and achieve economic, environmental, and social sustainability. The SSIA is an assembly of the most promising, affordable, and timely elements of the three preliminary approaches.

> The State Systemwide Investment Approach provides guidance for future State participation and programs for integrated flood management in the Central Valley.

Physical elements for the SSIA are organized into regional and system elements:

- **Urban**, **small communities, and rural-agricultural improvements –** These are physical actions or projects to achieve local and regional benefits.

- **System improvements –** These are projects and modifications to the SPFC that provide cross-regional benefits, improving the overall function and performance of the SPFC, and are generally large system improvements, such as bypass expansions. The State will provide leadership in developing and implementing these components.

The regional and system elements require detailed analyses to refine how elements may complement each other and to develop appropriate justification for future selection of on-the-ground projects. The SSIA reflects a broad vision for SPFC modernization; therefore, element refinements, additions, and deletions can be expected as a result of future feasibility studies.

Section 7 introduced elements of the SSIA. The following sections provide a more detailed description of the SSIA, its estimated cost, residual risk management needs, and a preliminary presentation of expected performance.

8.1 Major Physical Improvements in Sacramento and San Joaquin River Basins

Existing SPFC facilities in the Sacramento River Basin are much more extensive and protect larger populations and assets than SPFC facilities in the San Joaquin River Basin. In addition, peak floodflows from the Sacramento River Basin can be about 10 times higher than those from the San Joaquin River Basin. Therefore, physical improvements included in the SSIA are more extensive within the Sacramento River Basin than within the San Joaquin River Basin.

Table 8-1 shows important characteristics of the Sacramento and San Joaquin river basins.

Table 8-1. Key Characteristics of Sacramento and San Joaquin River Basins

Characteristics	Sacramento River Basin	San Joaquin River Basin
Land Area Within 500-Year (0.2 percent annual chance) Floodplain (acres)	**1,217,883**	**697,465**
Population at risk[1] (people)	762,000	312,000
Replacement value of assets at risk ($ millions)	53,000	16,000
Total SPFC Levees (miles)	**1,054**	**448**
SPFC Levees with identified threat factors[2] (miles)	852	354
Total Potential 2-Year (50 percent annual chance) Floodplains (acres)	**235,000**	**85,000**
Currently connected to river (acres)	93,000	26,000
Currently connected and in native/natural habitat (acres)	50,000	19,000
Total Reservoir Capacity[3] Tributary to Area (thousand acre-feet)	**10,477**	**7,100**
Reserved Flood Storage Space	3,066	1,881

Notes:
[1] Estimated population (from 2000 U.S. Census data) within 500-year floodplain.
[2] Source: *Flood Control System Status Report* (DWR, 2011). Includes Urban Levee Evaluations Project classifications “Marginal” and “Does Not Meet Criteria,” and Non-Urban Levee Evaluations Project categories B (Moderate) and C (Low).
[3] Only includes reservoirs with dedicated flood storage space.
Key:
SPFC = State Plan of Flood Control

Major physical (capital improvement) elements included in the SSIA are shown in Table 8-2 and in the schematics on Figures 8-1 and 8-2 for the Sacramento and San Joaquin river basins. The following sections provide more description of urban, small community, rural-agricultural, and system improvements.

Table 8-2. Major Physical and Operational Elements of Preliminary Approaches and State Systemwide Investment Approach

Flood Management Element	Project Location or Required Components	Achieve SPFC Design Flow Capacity	Protect High Risk Communities	Enhance Flood System Capacity		State Systemwide Investment Approach
Bypasses						
New Bypass Construction and Existing Bypass Expansion	• Feather River Bypass • Sutter Bypass expansion • Yolo Bypass expansion • Sacramento Bypass expansion • Lower San Joaquin River Bypass (Paradise Cut) Components potentially include land acquisition, conservation easements, levee improvements, new levee construction			YES	➔	YES
Reservoir Storage and Operations						
Forecast-Coordinated Operations/ Forecast- Based Operations	Fifteen reservoirs within Sacramento River Basin and San Joaquin River Basin	YES	YES	YES	➔	YES
Reservoir Storage/Enlarge Flood Pool[1]	• Oroville • New Bullards Bar • New Don Pedro • New Exchequer • Friant			YES		
Easements	• Sacramento River Basin – 200,000 acre-feet • San Joaquin River Basin – 100,000 acre-feet			YES		

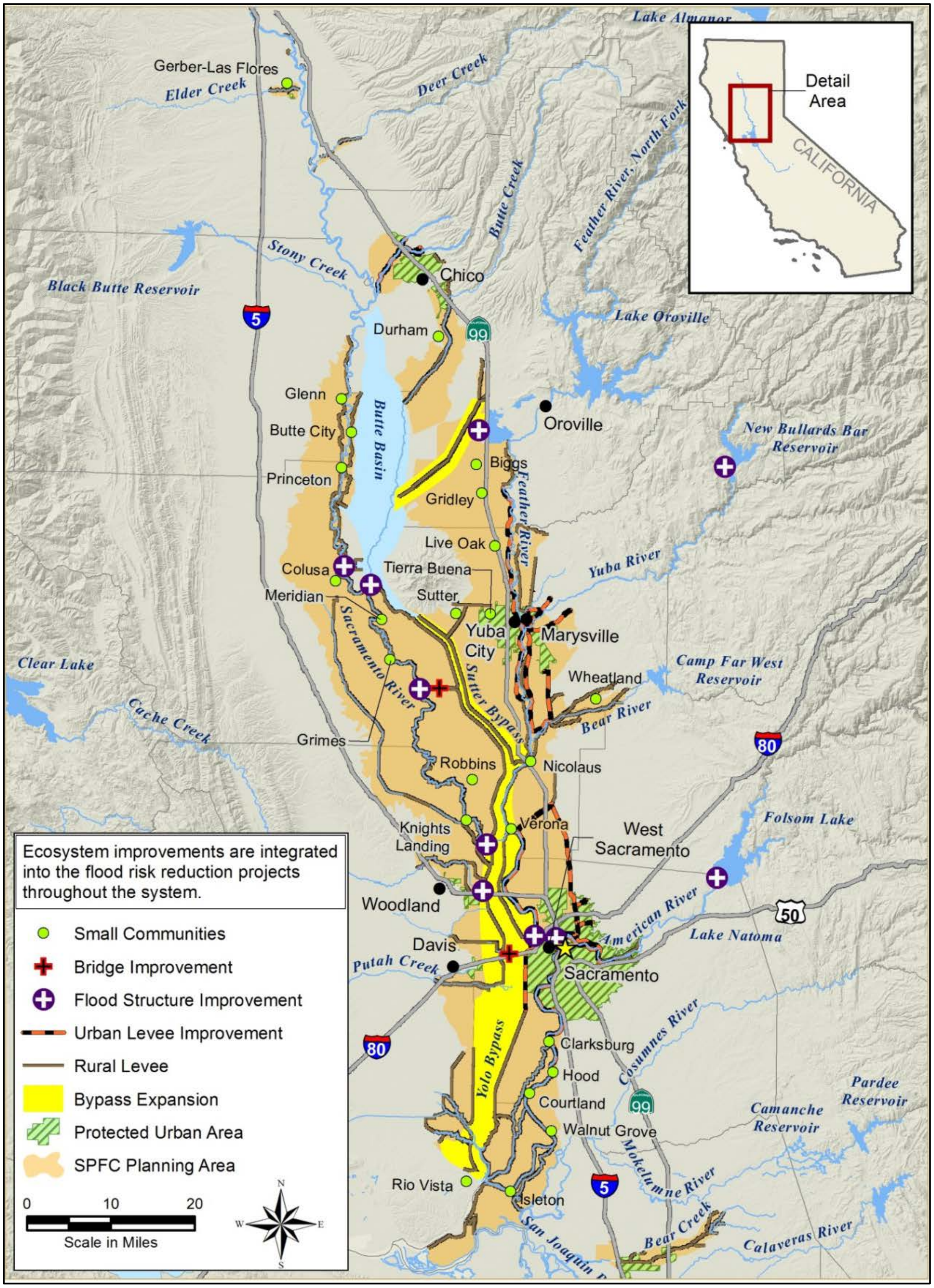
Table 8-2. Major Physical and Operational Elements of Preliminary Approaches and State Systemwide Investment Approach (contd.)

Flood Management Element	Project Location or Required Components	Achieve SPFC Design Flow Capacity	Protect High Risk Communities	Enhance Flood System Capacity		State Systemwide Investment Approach
Flood Structure Improvements						
Major Structures	• Intake structure for new Feather River Bypass • Butte Basin small weir structures • Upgrade and modification of Colusa and Tisdale weirs • Sacramento Weir widening and automation • Gate structures and/ or weir at Paradise Cut • Upgrade of structures in Upper San Joaquin bypasses • Low level reservoir outlets at New Bullards Bar Dam • Fremont Weir widening and improvement • Other pumping plants and small weirs			YES	→	YES
System Erosion and Bypass Sediment Removal Project	• Cache Creek Settling Basin sediment management • Sacramento system sediment remediation downstream from weirs			YES		YES
Urban Improvements						
Target 200-Year Level of Protection	Selected projects developed by local agencies, State, federal partners		YES	YES	→	YES
Target SPFC Design Capacity	Urban Levee Evaluations Project results	YES[2]				
Non-SPFC Urban Levee Improvements	Includes approximately 120 miles of non-SPFC levees that are closely associated with SPFC urban levees. Performance of these non-SPFC levees may affect the performance of SPFC levees.	YES	YES	YES		YES
Small Community Improvements						
Target 100-Year Level of Protection	Small communities protected by the SPFC		YES[3]	YES[3]	→	YES[4]
Target Design Capacity	Non-Urban Levee Evaluations Project results	YES[2]		YES[2]		
Rural-Agricultural Improvements						
Site-Specific Rural-Agricultural Improvements	Based on levee inspections and other identified critical levee integrity needs				→	YES
Target Design Capacity	Non-Urban Levee Evaluations Project results	YES[2]		YES[2]		

Table 8-2. Major Physical and Operational Elements of Preliminary Approaches and State Systemwide Investment Approach (contd.)

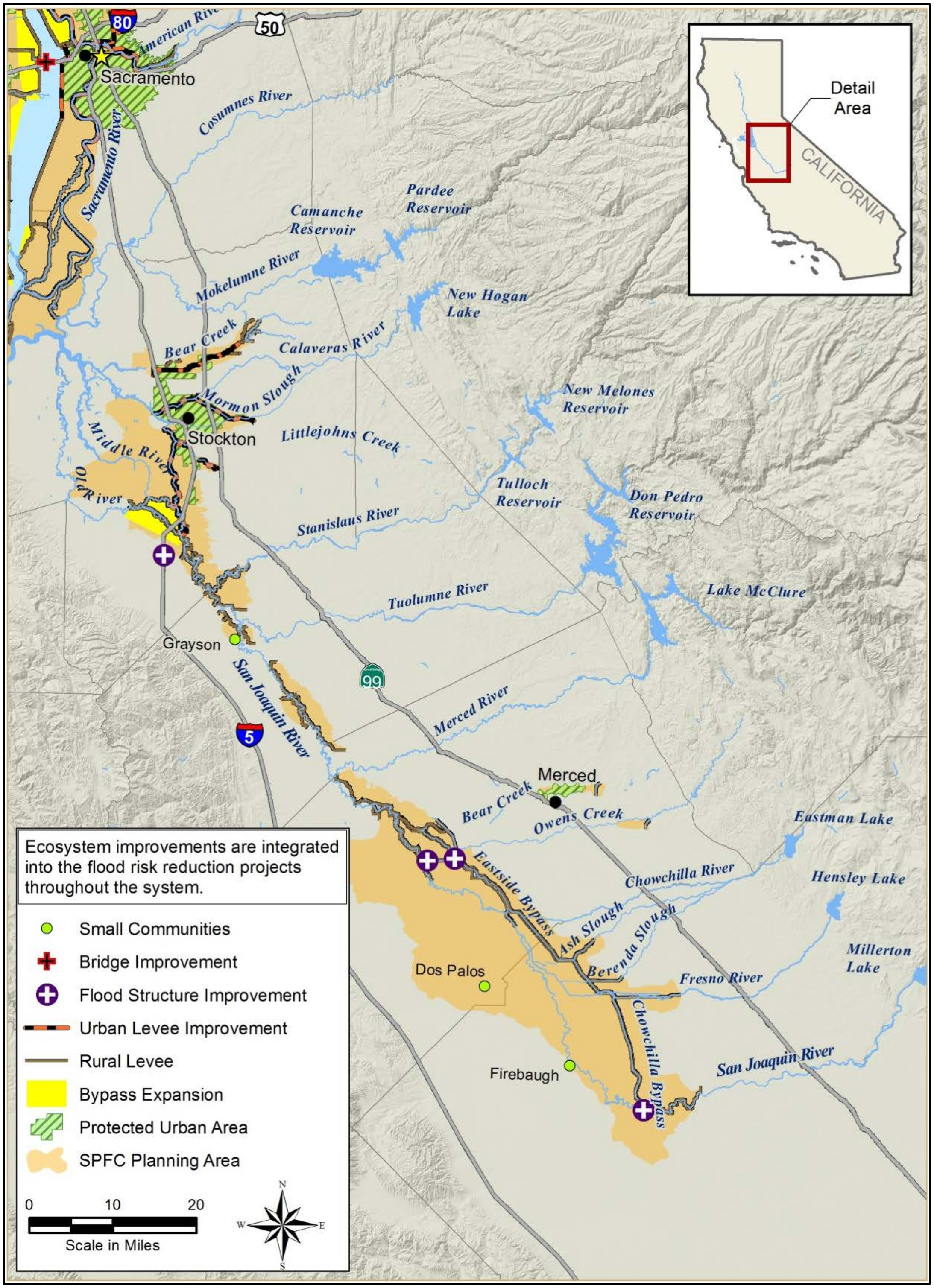
Flood Management Element	Project Location or Required Components	Achieve SPFC Design Flow Capacity	Protect High Risk Communities	Enhance Flood System Capacity		State Systemwide Investment Approach
Ecosystem Restoration						
Fish Passage Improvements	• Tisdale Bypass and Colusa Bypass fish passage • Fremont Weir fish passage improvements • Deer Creek			YES	➔	YES
Ecosystem Restoration and Enhancement	For areas within new or expanded bypasses, contributing to or incorporated with flood risk reduction projects			YES		YES
River Meandering and Other Ecosystem Restoration Activities	At selected levee setback locations in Sacramento and San Joaquin river basins			YES		YES (at select locations)

Notes:
[1] All preliminary approaches and State Systemwide Investment Approach include Folsom Dam Raise, as Congress authorized.
[2] Actual level of protection varies by location.
[3] Includes all small communities within the SPFC Planning Area.
[4] Includes selected small communities within the SPFC Planning Area.
Key:
SPFC = State Plan of Flood Control
State = State of California



Key: SPFC = State Plan of Flood Control

Figure 8-1. State Systemwide Investment Approach – Sacramento River Basin Major Capital Improvements Under Consideration



Key: SPFC = State Plan of Flood Control

Figure 8-2. State Systemwide Investment Approach – San Joaquin River Basin Major Capital Improvements Under Consideration

8.2 Urban Flood Improvements

Consistent with legislation passed in 2007, the SSIA proposes improvements to urban (populations greater than 10,000) levees to achieve protection from the 200-year (0.5 percent annual chance) flood, at a minimum. With some exceptions, existing SPFC levees in urban areas are often located immediately adjacent to houses and business, leaving few opportunities for setting levees back or making improvements that enlarge levee footprints. Therefore, reconstruction of existing urban levees is generally the method for increasing flood protection. The State is already supporting many SPFC urban levee improvement projects through its Early Implementation Program grants program and other FloodSAFE efforts, including some setback levees.

Central Valley Flood Protection Plan of 2008

California Water Code Section 9614. "The Plan shall include…

(i) A description of both structural and nonstructural methods for providing an urban level of flood protection to current urban areas where an urban area means the same as set forth in subdivision (k) of Section 5096.805 of the Public Resources Code. The description shall also include a list of recommended next steps to improve urban flood protection."

Improvements to urban levees or floodwalls should follow DWR's Urban Levee Design Criteria (2012), at a minimum. The State strongly supports consideration of features that offer greater system resilience, such as levees that can withstand overtopping without catastrophic breaching. Another example is to build compartmentalized floodplains (the use of secondary levees, berms, or elevated roadways within protected areas to reduce the geographic extent of flooding when a failure occurs).

Levee Resiliency

Reducing the risk of catastrophic system failure is an important aspect of flood risk reduction. Levee breaches increase flood losses and recovery costs, and lengthen the time needed to rebuild. USACE estimates that at least half of the direct losses from Hurricane Katrina may have been averted, had catastrophic breaching not occurred (*Building a Stronger Corps: A Snapshot of How the Corps is Applying Lessons Learned from Katrina* (USACE, 2009)).

Designing facilities to withstand overtopping and incorporating resiliency into overall system design not only help to reduce flood losses, but also provide flexibility to accommodate changing climate conditions, floodplain uses, and technical standards.

Levee projects in urban areas should consider setbacks, to the extent feasible, based on the level of existing development and the potential benefits. These projects should also preserve and/or restore, at minimum, shaded riparian habitat corridors along the waterside toe of levees. Other improvements will consider incorporating ecosystem preservation, restoration, and enhancements in project designs. Urban improvements should also be implemented and maintained consistent with the State's vegetation management approach (see CVFPP Section 4.2 and Attachment 2 – Conservation Framework).

In addition to urban area levees, other system and regional elements included in the 2012 CVFPP, such as reservoir operational changes and new or expanded bypasses, have the potential to contribute to achieving an urban level of flood protection. These elements could potentially reduce the need for urban area levee improvements, and/or provide additional system flexibility and resiliency in accommodating hydrologic uncertainty, including climate change.


Levee Improvements in Natomas

The 2012 CVFPP does not include improvements that may be needed to address interior drainage or other local sources of flooding. The State could pursue improvements to non-SPFC levees (see Section 8.6) that protect some urban areas even though the State has no responsibility over these levees at this time. The decision to add these levees to the SPFC would require Board action. Alternatively, the State may choose to participate in funding levee reconstruction or improvements, if found to be feasible.

DWR will evaluate and participate in projects (in-place and with setbacks, if appropriate) that contribute to achieving an urban level of flood protection through reconstructing, rehabilitating, or improving SPFC facilities for the following urban areas in the Central Valley:

- **City of Chico –** Improvements include reconstruction of existing SPFC urban levees bordering the City of Chico to provide protection from flooding along local tributaries.

- **Yuba City and City of Marysville –** Improvements for this metropolitan area and adjacent existing urbanizing corridor (along Highway 99 north of Yuba City, and along Highway 70 within and south of Marysville) include the following:

  - Continue work to reconstruct and/or improve SPFC levees to urban design criteria along the Feather and Yuba rivers immediately adjacent to Marysville, consistent with ongoing local efforts. The State is supporting ongoing work to achieve an urban level of flood protection for the City of Marysville as part of the Yuba Basin Project. This project encompasses four phases of levee improvements and other actions, with an ultimate goal of protecting Marysville from a 250-year (0.4 percent annual chance) flood event.

  - Continue to work with Sutter Butte Flood Control Agency to develop and implement projects to achieve an urban level of flood protection for Yuba City and adjacent existing urbanizing areas. This includes reconstructing and/or improving SPFC levees to urban design criteria along the right bank of the Feather River, adjacent to and upstream from Yuba City, as part of the Feather River West Levee Project.

- **Sacramento Metropolitan Area –** Improvements for this area include the following:

  - Reconstruct and/or improve SPFC levees protecting urban areas along the Sacramento and American rivers to urban design criteria, as needed, to complete ongoing urban flood protection improvements within Sacramento County (includes the Laguna portion of Elk Grove). The State has supported the Sacramento Area Flood Control Agency's urban flood protection projects through cost sharing and grant funding under the FloodSAFE Early Implementation Program. Completed work that supports the SSIA includes levee improvements along the American River under the American River Watershed Common Features Project, and elements of the South Sacramento County Streams Project. Ongoing work includes levee improvements under the Natomas Levee Improvement Program and construction of an auxiliary spillway at Folsom Dam as part of the Folsom Dam Joint Federal Project.

  - Reconstruct and/or improve SPFC levees to complete ongoing urban protection improvements for the City of West Sacramento. The State has supported urban levee improvements by the West Sacramento Area Flood Control Agency through the FloodSAFE Early Implementation Program grants program. Locally planned work, for potential State participation, includes levee reconstruction and raising, cutoff walls, setback levees, and erosion protection features.

  - Evaluate the potential benefits of widening, automation, and operational changes to the Sacramento Weir and Bypass for the purpose of reducing peak flood stage along the Sacramento and American rivers, in combination with expansion of the Yolo Bypass (described later under System Improvements). Weir automation and other improvements have the potential to improve operational safety and flexibility.

- **Cities of Woodland and Davis –** Continued participation in the Lower Cache Creek, Yolo County Woodland Area Feasibility Study, which considers modifications to the Cache Creek Settling Basin and other facilities to determine their feasibility and contribution toward achieving urban and rural-agricultural flood improvement in the area. Also evaluate the Cache Creek Settling Basin to identify a long-term program for managing sediment and mercury to maintain the flood conveyance capacity of the Yolo Bypass.

- **City of Merced –** Continued support of the Merced County Streams Project, which is contributing to improving flood protection for the City of Merced.

- **Stockton Metropolitan Area –** Improvements for this area include the following:

  - Improve SPFC levees along the San Joaquin River and tributary channels.

  - Evaluate the potential benefits of and State interest in local floodgates and control structures, as they relate to facilities of the SPFC in and around Stockton, and contribute to achieving an urban level of flood protection.

- **Other Areas –** For urban areas also protected by non-SPFC levees, the State may evaluate its interest in participating in levee improvements under other State programs.

8.3 Small Community Flood Protection

Many small communities in the SPFC Planning Area are expected to receive increased flood protection through implementation of system elements and improvements focused on adjacent urban areas, although some of these improvements may take many years to implement. The State will evaluate investments to preserve small community development opportunities without providing an urban level of flood protection. However, some small communities adjacent to existing urban areas may achieve a 100-year level of flood protection or higher as a result of improvements for the adjacent urban areas. Additional State investments in small community protection will be prioritized based on relative community flood threat levels, considering factors such as population, likelihood of flooding, proximity to flooding source, and depth of flooding. Other factors considered in prioritizing small community flood improvements include financial feasibility and achievement of the 2012 CVFPP Goals with respect to integrating multiple benefits.

In general, the State will consider the following structural and nonstructural options for protecting small communities in the SPFC Planning Area from a 100-year (1 percent annual chance) flood:

- Protecting small communities "in-place" using ring levees, training levees, or floodwalls when improvements do not exceed a certain predetermined cost threshold. For planning purposes for the SSIA, DWR used a preliminary cost threshold of $100,000 per house protected, an approximate value for elevating or flood proofing a house. When estimated costs exceed the threshold, nonstructural means for flood protection will be considered. DWR will further evaluate this threshold during future studies.

- Reconstructing or making improvements to adjacent SPFC levees.

- Implementing nonstructural improvements, such as raising/elevating structures, flood proofing, willing seller purchases, and/or relocating structures, when the in-place improvements described above are not feasible.

In some cases, small communities may achieve flood protection as part of adjacent urban area improvements.

As detailed in Table 8-3, 15 of the 27 small communities in the SPFC Planning Area would receive 100-year (1 percent annual chance) flood protection from about 80 miles of levee improvements or new levee construction based on planning level estimates. A new levee is one constructed from the ground up, not a levee that has been repaired in place. Another five small communities would receive 100-year (1 percent annual chance) flood protection, at minimum, through implementation of urban and system improvements included in the SSIA. Seven small communities would receive flood protection through floodplain management actions such as flood proofing or raising structures.

Improvements to small communities should also be implemented and maintained consistent with the State's vegetation management approach (CVFPP Attachment 2 – Conservation Framework). Other improvements will consider incorporating ecosystem preservation, restoration, and enhancements in project designs.

Table 8-3. Small Communities Improvements in the State Systemwide Investment Approach

Community in SPFC Planning Area	Levee Improvements or Construction	Urban and System Improvements	Floodplain Management Actions
Knights Landing	√		
Grayson	√		
Isleton			√
Walnut Grove			√
Meridian	√		
Courtland			√
Robbins			√
Hood			√
Firebaugh	√		
Colusa	√		
Durham	√		
Rio Vista	√		
Wheatland	√		
Gerber-Las Flores	√		
Glenn	√		
Clarksburg	√		
Verona			√
Grimes	√		
Princeton			√
Butte City	√		
Dos Palos	√		
Biggs		√	
Upper Lake			√
Gridley		√	
Live Oak		√	
Sutter		√	
Tierra Buena		√	

Key:
SPFC = State Plan of Flood Control

8.4 Rural-Agricultural Area Flood Protection

The rural-agricultural area levee improvements included in the SSIA are not as extensive as for urban areas and small communities, reflecting the lower levels of development within these floodplains.

8.4.1 State Plan of Flood Control Levees

The State recognizes that federal engineering guidance and design standards may result in cost-prohibitive levee repairs for many rural-agricultural areas. The State will work with rural-agricultural communities to develop applicable rural levee repair criteria for SPFC levees. The State will also evaluate investments to preserve rural-agricultural activities that discourage incompatible development, and encourage compatible development, within floodplains.

The State's participation in rural-agricultural SPFC facility reconstruction projects may also require inclusion of nonstructural measures to manage risks in adjacent floodplains, such as purchasing agricultural conservation easements from willing landowners, where consistent with local land use plans. In addition to improving flood management, project designs will consider restoring shaded riparian aquatic habitat, wetlands, or other habitat. This includes protection and enhancement of existing healthy ecological communities, in addition to the enhancement/restoration of degraded ecosystem services and functions. Flood risk reduction projects in rural-agricultural areas that can achieve multiple resource benefits will be preferable to single purpose projects, and are likely to be encouraged through enhanced State and federal cost-sharing.

In general, the State will consider the following rural-agricultural flood protection options, with a focus on integrated projects that achieve multiple benefits:

- SPFC levee improvements in rural-agricultural areas will focus on maintaining levee crown elevations and providing all-weather access roads to facilitate inspection and floodfighting.

- Levee improvements, including setbacks, may be used to resolve known performance problems (such as erosion, boils, slumps/slides, and cracks). Projects will be evaluated that reconstruct rural SPFC levees to address identified threat factors, particularly in combination with small community protection, where economically feasible.

- Agricultural conservation easements that preserve agriculture and prevent urban development in current agricultural areas may be purchased, when consistent with local land use plans and in cooperation with willing landowners.

The State, in consultation with local entities, will prioritize available funding among all-weather roads and other important investments, addressing the greatest need first.

8.4.2 Hydraulic Structure Upgrades

In addition to hydraulic structures mentioned as part of urban and system improvements, existing hydraulic structures in the upper San Joaquin River Basin need to be upgraded because of facility age or operational problems. In some cases, gates do not operate properly, new automation is needed, or the structures are otherwise deteriorated.

8.4.3 Local Non-State Plan of Flood Control Levees

During future feasibility studies, the State will evaluate projects to maintain the function of local levees (not part of the SPFC) if they contribute to the effective operations and maintenance of the SPFC. The State may be able to participate through existing programs on feasible projects.

8.4.4 Removal of State Plan of Flood Control Facilities

The State will evaluate potentially removing (physically or administratively) facilities of the SPFC in rural areas, including rock revetment, levees, and other facilities, consistent with criteria presented in CVFPP Section 4. Removing small portions of the SPFC that are no longer functioning would reduce the State's responsibility and costs for operations and maintenance. Facilities that may be evaluated for potential removal from the SPFC include the following:

- A two-mile long segment of the Feather River right-bank levee, upstream from the Thermalito Afterbay, which was replaced by an embankment constructed to create Thermalito Afterbay (on its southeast side).

- Approximately seven miles of levee included in the Lower San Joaquin River and Tributaries Project, which is currently being physically breached and removed. This effort is part of a nonstructural project modification, under the authority of Public Law 84-99, following damage during the 1997 floods.

- Intermittent SPFC levees along reaches of the San Joaquin River and in the vicinity of the Mariposa Bypass and Deep Slough. If pursued, removal projects should consider integration of wetland, riparian, and floodplain habitat restoration.
- Some existing, intermittent bank protection sites along the Sacramento River between Red Bluff and Chico Landing, now unconnected with the active river channel and believed to no longer provide a flood management function by erosion control.
- Levees and pumping plants from the Middle Creek Project at the west end of Clear Lake, for which removal is currently underway. Facilities removal was authorized by Congress in the Water Resources Development Act of 2007.

8.5 System Improvements

Floodflow over the Moulton Weir

System elements include physical actions or improvements with the potential to provide benefits across large portions of the flood management system, and improve the overall function and performance of the SPFC in managing large floods. These actions enhance the system's overall ability to convey and attenuate flood peaks through expansion of bypass capacity and storage features. System improvements provide flood protection benefits to urban, small community, and rural-agricultural areas by lowering flood stages.

These actions also present significant opportunities to improve ecosystem functions and continuity on a systemwide level. System improvements should also be implemented and maintained consistent with the State's vegetation management approach (see Section 4.2 of the CVFPP and Attachment 2: Conservation Framework).

The following sections describe system elements included in the SSIA.

8.5.1 Weir and Bypass System Expansion

The Sutter and Yolo bypasses, in combination with their appurtenant control features – the Moulton, Colusa, Tisdale, Fremont, and Sacramento weirs/bypasses – function as the central backbone of the Sacramento River Flood Control Project. This weir and bypass system redirects damaging floodflows away from the main channels of the Sacramento, Feather, and American rivers, conveying up to 490,000 cubic feet per second during large flood events. The considerable capacity of the bypass system also slows the movement of floods, effectively attenuating flood peaks and metering flows into the Delta. For initial planning purposes, technical evaluations are based on construction of all bypass expansions and extensions described below.

Bypass expansions would increase the overall capacity of the flood system to convey large flood events. Peak flood stages would be reduced along the Sacramento River and, to a lesser extent, along its tributaries. The lower stages throughout the system benefit flood management in urban, small community, and rural-agricultural areas. Floods from storms centered within different watersheds of the Sacramento River Basin have different characteristics, and bypass system expansion would contribute to greater system flexibility in managing these different flood events.

Improvements would be designed and operated in consideration of ecosystem restoration features and benefits, including conservation and restoration of aquatic and floodplain habitats and continued compatible agricultural land uses within the bypass. Improvements may include contouring and channelizing to facilitate proper draining and to lessen the possibility of entraining fish. Contouring may also increase the frequency of floodplain activation in places to promote wetland and riparian habitat success. When consistent with local land use plans, and in cooperation with willing landowners, the State will consider purchasing agricultural conservation easements adjacent to the Sutter and Yolo bypasses to preserve agriculture and prevent urban land uses.

Sutter Bypass Expansion

Future studies to refine specific project elements related to bypass expansion should consider increasing the capacity of the Sutter Bypass to convey large flood events. Expansion would likely require building a new levee for about 15 miles along one side of the bypass to widen the bypass for increased flow capacity. Although the required width of the bypass has not been determined, DWR used a 1,000-foot increase in the bypass width for planning purposes. The evaluations for planning purposes were initially based on 75 percent of the new width allocated to agricultural use and 25 percent allocated to habitat restoration.

Modifications to the Colusa and Tisdale weirs and the Butte Basin overflow areas from the Sacramento River will be considered as part of the expansion. The expansion may require rebuilding some SPFC facilities, such as weirs and pumping stations.

Yolo Bypass Expansion

Future studies to refine specific project elements related to bypass expansion should consider the following:

- Lengthening and/or lowering the Fremont Weir and incorporating features to facilitate fish passage through the upper bypass and at the weir
- Increasing capacity in the upper portion of the Yolo Bypass (upstream from the Sacramento Bypass) by setting back levees and/or purchasing easements
- As described under Section 8.2, evaluate the Cache Creek Settling Basin to identify a long-term program for managing sediment and mercury to sustain the flood conveyance capacity of the Yolo Bypass
- Expanding the lower end of the Yolo Bypass upstream from Rio Vista by setting back levees

About 42 miles of new levee could potentially be required to expand the Yolo Bypass.

Sacramento Bypass Expansion

As part of urban elements to reduce flood risks to the Sacramento/West Sacramento metropolitan area, future studies to refine specific project elements related to bypass expansion (also mentioned under Urban Flood Improvements) will consider the following:

- Widening the Sacramento Weir
- Automating the weir or eliminating gates
- Widening the Sacramento Bypass by constructing about two miles of new levee
- Making operational changes to the Sacramento Weir and Bypass, as necessary

8.5.2 New Bypasses

Two new bypasses are included in the SSIA. While they would primarily provide benefits to the urban areas of Yuba City/Marysville and Stockton, they are described here with other system improvements because of their complexity and long lead time for construction.

Feather River Bypass

Evaluate the feasibility of constructing a new bypass from the Feather River to the Butte Basin to further contribute to improving overall urban, small community, and rural-agricultural flood protection in the planning area. The new bypass would require construction of about 16 miles of new levee on one side of the Cherokee Canal. A new bypass would have the potential to reduce flood stages by as much as one foot at Yuba City and Marysville during a 100-year (1 percent annual chance) flood. A new bypass would also provide greater system resiliency in accommodating future hydrologic changes in the planning area, including those due to climate change, and would be a relief path when Feather River flows are greater than 200-year (0.5 percent annual chance). The State will consider findings of ongoing studies by local entities when evaluating the potential system benefits of the bypass.

Lower San Joaquin Bypass

Evaluate the construction of a new bypass in the south Delta (expansion of Paradise Cut and/or other south Delta waterways), primarily for the purpose of reducing peak flood stages in the Stockton area. A south Delta bypass would include habitat components. A gate structure or weir at Paradise Cut will be considered as part of the project. The new bypass would require construction of about eight miles of new levee. In combination with the bypass, the State will consider purchasing easements in the south Delta from willing sellers to provide floodwater storage and reduce peak flood stages along the San Joaquin River.

8.5.3 Flood System Structures

Several flood system structures will require rehabilitation, rebuilding, or modifications. These structures are primarily associated with the bypass expansions and new bypasses described above. Structures include the following:

- Intake structure for the new Feather River Bypass
- Butte Basin small weir structures
- Upgrade and modification of Colusa and Tisdale weirs

- Modifications to bridges to reduce or eliminate flow constrictions
- Sacramento Weir widening and either automation or elimination of gates
- Gate structures and/or weir for new Lower San Joaquin Bypass.
- Low-level reservoir outlet at New Bullards Bar Dam to facilitate changes in reservoir operations
- Other pumping plants and small weirs, such as those associated with the Sutter Bypass

In addition, opportunities to expand fish passage at SPFC structures will be considered.

8.5.4 Flood Storage

Preliminary systemwide analyses have identified potential benefits and opportunities for reservoir flood storage and operational changes for flood management in the Sacramento River and San Joaquin river basins.

Flood storage may reduce the need for some types of downstream actions, such as levee improvements, and can offset the hydraulic effects of system improvements on downstream reaches. Additional flood storage can also provide greater flexibility in accommodating future hydrologic changes, including climate change, and provide greater system resiliency (similar to that provided by freeboard on levees) in the face of changing downstream conditions.

New Reservoir Storage

The only new surface water storage included in the SSIA is the Folsom Dam Raise, which is already authorized. During future feasibility studies, the State may consider partnering with other willing agencies on expanding existing reservoir storage.

Transitory Storage

The SSIA has not identified specific floodplain transitory storage, but may consider such storage on a willing-seller basis where consistent with local land use plans, all affected land owners support such storage, and the new flood storage area can be safely isolated from adjacent areas (easements or fee title).

8.5.5 Conjunctive Use and Groundwater Recharge

Capturing and using floodflows for groundwater recharge has been considered as a component of integrated flood and water management for the SSIA. Conjunctive water management through use of floodwater for recharge has been practiced for many years, especially in the San Joaquin Valley. The State supports programs that use flood flows for groundwater recharge to improve water management throughout California. However, the State also recognizes the limitations of direct groundwater recharge in lowering flood stage and reducing flood risks, especially in the Sacramento River Basin. These limitations are due to inadequate groundwater storage capacity, except in the American River Basin, and low recharge rates in comparison with large floodflows. More substantial recharge capacities cannot be achieved without significant investments in off-stream recharge facilities or regional infrastructure to facilitate in-lieu recharge, such as those North of the American River in the Sacramento metropolitan area. Consistently, these facilities are developed by local agencies with emphases on water supply purposes. Considering these limitations, the SSIA provides opportunities for in-channel groundwater recharge and, although not recommending any specific recharge projects at this time, encourages exploring recharge opportunities in the San Joaquin River Basin, especially for capturing a portion of high flows from snowmelt, where feasible.

8.5.6 Operational Changes

Operational changes to SPFC facilities can benefit both flood risk reduction and the ecosystem. Initial concepts for operational changes are described below for existing reservoirs and the bypasses.

Coordinated Reservoir Operations

Most major reservoirs in the Central Valley have been designed and built to meet multiple purposes, including water supply, recreation, and flood control. These multipurpose reservoirs have defined water conservation space for capturing winter and spring runoff for water supply purposes, and designated flood control space to capture, manage floodflows to reduce flood releases downstream.

The Forecast-Coordinated Operations (F-CO) Program seeks to coordinate flood releases from the reservoirs located in various tributaries of a major river to optimize the use of downstream channel capacity, the use of total available flood storage space in the system, and eventually to reduce overall peak floodflows downstream from these reservoirs. The management process and partnerships, formed during early development of the F-CO Program, contribute significantly to enhanced coordination of reservoir operations during flood events.

Implementing Forecast-Based Operations (F-BO) of Central Valley reservoirs is the next logical step in advancing the F-CO Program. The intended F-BO would involve the use of improved long-term runoff forecasting and operating within the parameters of an existing flood control diagram. Proactive reservoir management through the use of more flexible flood control diagrams would require extensive studies of the most feasible diagrams, environmental documentation for changing reservoir operations, and Congressional approval for a new dynamic flood control diagrams. The SSIA includes implementation of both F-CO and F-BO for all reservoirs in the Central Valley.

As part of early FloodSAFE implementation, operators at Lake Oroville and New Bullards Bar Reservoir have begun coordinating flood operations to better manage downstream flows on the Yuba and Feather rivers. The coordinated operation of New Bullards Bar Reservoir with Lake Oroville will require construction of an outlet to accommodate early releases of floodflows from New Bullards Bar Dam; preliminary evaluations indicate that a new outlet with a capacity of about 20,000 cubic feet per second should be considered.

Water Flowing from Sacramento River to Yolo Bypass Through Sacramento Weir and Bypass

In addition, DWR will consider willing partnerships with other reservoir operators to accomplish F-BO and overall F-CO program objectives.

Weir and Bypass Operational Changes

The State proposes to investigate modifying the function and operation of weirs that spill floodwater to the bypasses in the Sacramento River Basin. The concept is to physically lower crests of overflow weirs and modify operations so that bypasses carry flows earlier and for longer durations during high river stages. These changes would reduce river stages and flood risks along main rivers. Depending on timing, duration, and a host of related hydraulic factors, the more frequently activated floodplain in the bypasses would potentially provide a more productive rearing habitat for juvenile salmonids and other native fish and may provide riparian habitat.

One potential change in operations is for the Sacramento Weir, which is currently opened when the Sacramento River water surface elevation reaches 27.5 feet at the I Street Bridge. Evaluation may show that opening the weir when the river stage reaches 25 feet provides improvements in both flood management and ecosystem function. Similarly, the crest of the Fremont Weir may be lowered or other modifications made to provide flow to the Yolo Bypass below its current spill stage. Other structures that would be subject to assessment and potential operational modifications include Moulton, Colusa, Tisdale, and Paradise Cut weirs.

Evaluations would also need to consider the extent of potential impacts from more frequent and longer durations of flooding in the bypasses. For example, some levees along the bypasses may not be as durable as levees along the main rivers – levee reliability could be lowered by longer duration wetting. Longer duration flooding of the bypasses would increase the duration of levee patrols. Also, extending the duration of bypass flooding could interfere with ongoing agricultural practices.

8.5.7 Features to Mitigate Potential Flood Stage Increases

Since future feasibility studies are needed to refine the SSIA, the ultimate configuration of facilities will likely vary from those presented in the SSIA. Only at that time will the State know the potential magnitude and extent of hydraulic impacts from planned improvements, if any, within the system. Cost estimates for the SSIA include an allowance for features to mitigate significant hydraulic impacts caused by project implementation.

A number of mitigation features may be used, depending on the hydraulic impacts throughout the system and downstream from SPFC facilities. Mitigation features may include the following:

- Levee enhancements for affected areas
- New surface storage partnerships with willing reservoir operators
- New transitory storage
- Modification of project designs to limit stage increases
- Other features that appear promising during feasibility studies

8.6 Non-State Plan of Flood Control Levees

Approximately 420 miles of private non-SPFC levees are closely associated with SPFC levees. These non-SPFC levees; (1) abut SPFC levees, (2) have performance that may affect performance of SPFC levees, or (3) provide flood risk reduction benefits to areas also being protected by SPFC features.

8.6.1 Non-State Plan of Flood Control Urban Levees

A total of about 120 miles of non-SPFC urban levees work in conjunction with SPFC levees to provide protection to urban areas within the SPFC planning area. Table 8-4 shows the distribution of non-SPFC levees for the various urban areas. Figure 8-3 shows the locations of these non-SPFC urban levees.

To achieve 200-year (0.5 percent annual chance) flood protection, improvements to both SPFC and non-SPFC levees will be needed. DWR has estimated that improving these non-SPFC urban levees to achieve this level of protection would cost approximately $1.2 billion in 2011 dollars. This cost is included in the SSIA costs.

The State recognizes that for an urban area protected jointly by both SPFC and non-SPFC levees, the legislated requirement for an urban level of flood protection (200-year or 0.5 percent annual chance flood) requires improvement to both types of facilities. The Board may choose to treat some or all these non-SPFC levees in a similar manner to SPFC urban levees for State participation in levee improvements, and potentially add them to the SPFC. Alternatively, if the Board chooses not to add these levees to the SPFC, the State will consider participation in improvements to these levees under other State programs.

Table 8-4. Non-State Plan of Flood Control Urban Levees

Urban Area	Non-SPFC Levees (miles)
Chico	0
Yuba City	0
Marysville	0
Sacramento	24
West Sacramento	30
Woodland	1
Davis	0
Stockton	65
Merced	0
Total	120

Key:
SPFC = State Plan of Flood Control

In addition, completed and ongoing projects under the Early Implementation Program (EIP) initiated since bond funding became available in 2007 will likely be added to the SPFC when final documentation is complete.

In addition, completed and ongoing EIP projects initiated since bond funding became available in 2007 will likely be added to the SPFC when final documentation is complete.

8.6.2 Non-State Plan of Flood Control Nonurban Levees

About 300 miles of non-SPFC nonurban levees work in conjunction with SPFC levees in rural areas. Most of these levees are along the upper San Joaquin River. Figure 8-3 shows the locations of non-SPFC nonurban levees that protect portions of the SPFC Planning Area. Non-SPFC Delta levees are not included since they do not protect the SPFC Planning Area.

Improving these levees to the same level as SPFC rural levees would cost about $300 million. This cost is not included in the costs for the SSIA. Portions of these non-SPFC nonurban levees may be candidates for being added to the SPFC after preparation of regional plans and feasibility studies (see CVFPP Section 4), but DWR has not included them as part of the SSIA.

Non-SPFC Levees in the State Systemwide Investment Approach

- *Improvements to urban non-SPFC levees are included in the SSIA if the non-SPFC levees work in conjunction with SPFC levees to protect the SPFC Planning Area*
- *Improvements to non-urban non-SPFC levees are not included in the SSIA*

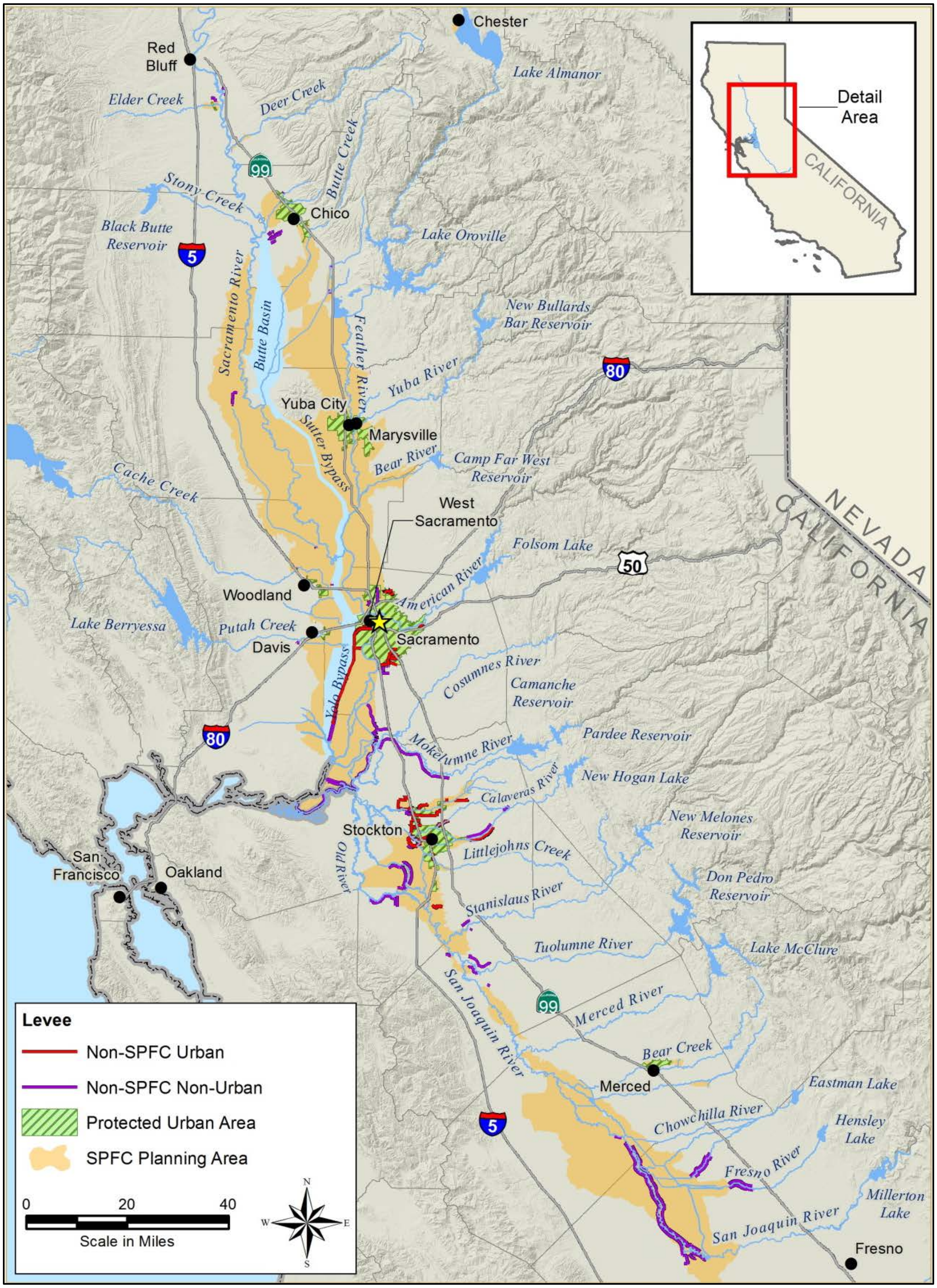


Figure 8-3. Non-State Plan of Flood Control Levees Protecting Portions of State Plan of Flood Control Planning Area

8.7 Integrating Ecosystem Restoration Opportunities with Flood Risk Reduction Projects

While flood risk reduction (public safety) remains the primary goal of the 2012 CVFPP, early integration of other important resource management goals into the plan formulation process remains a premise of integrated flood management. Those supporting goals, along with the legislative objectives, are described in Section 5. This will help improve overall flood project delivery and may broaden public support for flood projects.

In taking an integrated flood management approach, the intent of the SSIA is to make progress on improving ecological conditions on a systemwide basis, using integrated policies, programs, and projects. This approach builds upon and advances on-going efforts and successes to incorporate environmental benefits into flood management projects. Integrating environmental stewardship early into policy and project planning, development, and implementation will help move beyond traditional project-by-project compensatory mitigation. This approach also creates the opportunity to develop flood management projects that may be more sustainable and cost-effective, and can provide ecological benefits while protecting public safety. Under the SSIA, ecosystem restoration opportunities are integral parts of system improvements, as well as urban, small community, and rural-agricultural area flood protection projects.

Attachment 2 to the CVFPP, the Conservation Framework, provides a preview of a long-term Central Valley Flood System Conservation Strategy (Conservation Strategy) that DWR is developing to support the 2017 update of the CVFPP. The Conservation Framework focuses on promoting ecosystem functions and multi-benefit projects in the context of integrated flood management for near-term implementation. The Conservation Framework provides an overview of the floodway ecosystem conditions and trends and key conservation goals that further clarify the 2012 CVFPP ecosystem goal. The Conservation Framework also identifies opportunities for integrated flood management projects that can, in addition to improving public safety,

Central Valley Flood Protection Act of 2008

California Water Code Section 9614.

"The Plan shall include…

(j) A description of structural and nonstructural means for enabling or improving Systemwide riverine ecosystem function, including, but not limited to, establishment of riparian habitat and seasonal inundation of available flood plains where feasible."

California Water Code Section 9616.

"The Plan shall meet…multiple objectives…including…

(7) Promote natural dynamic hydrologic and geomorphic processes.

(9) Increase and improve the quantity, diversity, and connectivity of riparian, wetland, flood plain, and shaded riverine aquatic habitats, including the agricultural and ecological values of these lands.

(11) Promote the recovery and stability of native species populations and overall biotic community diversity."

enhance riparian habitats, provide connectivity of habitats, restore riparian corridors, improve fish passage, and reconnect the river and floodplain.

The long-term Conservation Strategy will be consistent with the Conservation Framework and provide a comprehensive, long-term approach for the State to achieve the objectives of the Central Valley Flood Protection Act and the FloodSAFE and CVFPP goals. Flood protection projects that are integrated with environmental restoration components have the potential to increase federal and State cost-sharing for flood management projects and make improvements more affordable for local entities.

Consistent with the Conservation Framework, ecosystem restoration and enhancement opportunities of the SSIA include the following:

- **Regional improvements (urban, small community, and rural-agricultural areas) –** Flood protection projects will preserve important shaded riparian aquatic habitat along riverbanks and help restore the regional continuity/connectivity of such habitats. Planning and designs for flood risk reduction projects will consider opportunities to enhance ecosystem functions.

- **System improvements –** DWR, through its multiple programs, will continue to work on integrated flood management projects within the Systemwide Planning Area, and will evaluate and initiate other projects that benefit the SPFC. Sutter and Yolo bypass expansions (described previously) may increase the overall area of floodplain that would support wetland habitats.

- **Fish passage improvements –** Improve fish passage at SPFC weirs, bypasses, and other flood management facilities undergoing modification or rehabilitation to improve access to upstream aquatic habitat and facilitate natural flow routing. Possible candidates for fish passage improvements include the following:

  - Big Chico Creek system

  - Tisdale and Colusa weirs

  - Cache Creek Settling Basin

  - Fremont Weir

  - Yolo Bypass

  - Willow Slough Weir in Yolo Bypass

- Sacramento Weir
- Sand Slough Control Structure

DWR's goal in integrating ecosystem restoration and enhancement is to achieve overall habitat improvement, thereby reducing, or eliminating the need to mitigate for most ecosystem impacts. However, depending on the timing of improvements and implementation, some ecosystem mitigation may be required.

8.8 Climate Change Adaption Strategy

Climate change is likely to generate more extreme floods in the future. Development of flood hydrology that accounts for the potential effects of climate change is a complicated and time-consuming exercise that must account for many uncertainties. DWR, in partnership with the USACE, is in the process of developing new hydrology that includes the effects of climate change, but that hydrology will not be ready for use in system evaluation until late 2012. Therefore, the new hydrology will be most useful in technical evaluations leading to the 2017 update of the CVFPP.

Even though climate change hydrology was not yet available, development of the SSIA included allowances for potentially higher flows due to climate change. Providing wider bypasses to lower floodwater surface elevations would increase flow-carrying capacity and flexibility to deal with higher flood flows that may occur because of climate change. Changes in reservoir operations from F-CO and F-BO can provide flexibility and adaptability to changes in extreme flood events. In addition, the SSIA includes the potential for the State to participate with others in reservoir expansion projects and in obtaining rights for floodplain transitory storage from willing landowners. These and other strategies to address the effects of climate change will be further evaluated for the 2017 update of the CVFPP.

Climate Change

Climate change impacts for extreme events, such as flooding and droughts, will result not from changes in averages, but from changes in local extremes. DWR initiated a study to investigate a new approach to assessing impacts based on climate change indices more suitable for flood events – "*Atmospheric Rivers*." Preliminary findings are promising for:

- *Assessing climate change impacts on flood management and to communities receiving flood protection*
- *Identifying prudent system improvements that are resilient in climate change conditions*

DWR intends to continue methodology development and application for the 2017 CVFPP Update. *"Stability of native species populations and overall biotic community diversity."*

The effects of sea level rise are important in the Sacramento-San Joaquin Delta, portions of which are protected by SPFC facilities. Sea level rise will affect levees within the Delta and for some distance upstream along the rivers. The estimated average sea level rise is currently under the review of the National Research Council. For the 2012 CVFPP, high tide conditions during the 1997 flood were used as the boundary conditions for hydraulic analysis and could be considered an initial, surrogate condition under climate change. This tide was about two feet higher than would normally be expected on the basis of solar and lunar gravitational forces that create tides. DWR will continue to coordinate with other DWR programs, Delta Stewardship Council's Delta Plan, and ongoing USACE feasibility studies to collectively address how sea level rise could contribute to potential estuary flooding in the Delta.

For the 2017 CVFPP update, improved sea level rise information will be used. DWR will develop approaches for addressing sea level rise that may vary depending on the expected range and rate of sea level rise. For example, these approaches may vary from abandoning some facilities to raising and strengthening affected levees. Some affected areas may be transformed to ecosystem uses. Other management approaches may be considered, as supported by technical analysis during the preparation of regional plans and feasibility studies.

DWR is developing a new methodology for estimating the impacts of climate change on flood hydrology. Typical climate change impact assessments for long-term water supply needs consider likely changes in average temperature and precipitation. However, climate change impacts on extreme events, such as floods, will not result from changes in averages, but from changes in local extremes. Therefore, DWR collaborated with the National Oceanic and Atmospheric Administration, U.S. Geological Survey, USACE, and Reclamation in developing a new methodology based on the intensity of "Atmospheric Rivers," which are fast-moving, concentrated streams of water vapor that can release heavy rains. Since the moisture source of water vapors is often the ocean southwest of the Hawaiian Islands, these storm events are often referred to as Pineapple Expresses.

Since available climate change information does not present probabilistic characteristics, DWR is working on the concept of prudent decision making that focuses on investments that could accommodate a broader range of climate change scenarios rather than optimizing investments within a few selective scenarios. The resulting Threshold Analysis Approach was applied to the Yuba-Feather system in a proof-of-concept pilot study. The results of the pilot study suggest that under the F-CO, New Bullards Bar Dam on the Yuba River has inadequate capacity to help respond to climate change, as compared to Oroville Dam on the Feather River, because of limited regulating capacities. This information provides guidance for the overall investment strategy for modifications such as enlarged outlets at New Bullards Bar Dam. DWR intends to fully develop the Threshold

Analysis Approach for the 2017 Update with new Central Valley hydrology and improved Atmospheric River indices (see 2012 CVFPP Attachment 8k – Climate Change Analysis).

In summary, improved climate change information will allow more detailed evaluation of potential climate change impacts on the SPFC and refinement of approaches to manage higher floodflows and sea levels during preparation of regional plans and feasibility studies.

8.9 Considerations for Sacramento-San Joaquin Delta

Land uses in the Delta outside the SPFC Planning Area are primarily rural and dominated by agriculture and open space, with several dispersed small communities. Flood management facilities primarily include levees, which often protect lands at or below sea level. Flood management responsibilities in Delta areas outside the SPFC Planning Area reside with a variety of local agencies, supported by the State's Delta Special Flood Projects Program and Delta Levees Maintenance Subventions Program.

Restoration of ecosystem functions and aquatic habitats in the Delta have been, and continue to be, the focus of various State, federal, and local efforts, in addition to water supply and flood management planning. Major efforts include the Delta Stewardship Council's Delta Plan, the Delta Protection Commission's Economic Sustainability Plan, the Bay Delta Conservation Plan, and the Delta Habitat Conservation and Conveyance Program.

The CVFPP supports a financially and environmentally sustainable Delta. Depending on which elements of the SSIA are eventually implemented in upstream regions, there is a potential for hydraulic impacts in the Delta. The SSIA includes management actions (see Section 5), and a cost allowance, to lessen or mitigate these impacts compared with current conditions.

The State will continue to support Delta flood management improvements outside the SPFC Planning Area through existing programs and in coordination with ongoing multiagency Delta planning efforts. Existing programs include the Statewide Flood Management Planning Program, Delta Levees Maintenance Subventions Program, Delta Special Flood Control Projects program, emergency planning and response support, and other residual risk management programs and support provided by the State.

8.10 U.S. Army Corps of Engineers Levee Vegetation Policy and Public Law 84-99 Eligibility

The USACE levee vegetation management policy affects implementation of the SSIA and its ability to maintain eligibility for federal Public Law 84-99 rehabilitation assistance in the event of flooding. The following provides context for the USACE policy and the State's resultant levee vegetation management strategy described in CVFPP Section 4. A more detailed description of the levee vegetation management issue can be found in Attachment 2 – Conservation Framework.

8.10.1 U.S. Army Corps of Engineers Levee Vegetation Policy

In April 2007, USACE released a draft white paper, Treatment of Vegetation within Local Flood Damage Reduction Systems, which clarified its nationwide policy regarding the removal of wild growth, trees, and other encroachments as a prerequisite for Public Law 84-99 eligibility. The USACE policy requires removal of all woody vegetation from levee slopes and toe areas. This policy is not consistent with the USACE "vegetation variance letter" dated August 3, 1949, which revised the Standard O&M Agreement to include the following text: "Brush and small trees may be retained on the waterward slope where desirable for the prevention of erosion and wave wash. Where practicable, measures shall be taken to retard bank erosion by the planting of willows or other suitable growth on areas riverward of the levees." The 2007 policy is also not consistent with the long-standing USACE practice of protecting trees while performing levee repairs on Central Valley levees, and requiring new tree planting in its levee designs, where feasible.

USACE has proposed the new levee vegetation policy to improve levee integrity and reduce flood risk. The Flood Control System Status Report includes DWR's assessment of the safety risks associated with trees and shrubs on, and adjacent to, levees. The report concludes that properly trimmed and spaced levee vegetation poses a low threat to levee integrity in comparison with other risk factors, and can help stabilize soils and reduce nearshore flow velocities. DWR does not believe that the presence of properly maintained woody vegetation on "legacy levees" constitutes a degree of risk that necessarily requires removing vegetation or constructing engineered works to address the perceived risk. Instead, DWR believes such "legacy levee vegetation" needs to be considered in a balanced recognition of its role to the ecosystem and to the levee's integrity.

A preliminary assessment by DWR has also concluded that the complete removal of existing woody vegetation along the 1,600-mile legacy Central Valley levee system would be enormously expensive, would divert investments away from more critical threats to levee integrity, and would be environmentally devastating. Recent USACE research regarding the risks associated with trees on levees found that trees can slightly increase or decrease levee safety, depending on their location on the levee slope. While concluding that more research is needed, the research did not characterize levee vegetation as a major risk factor.

Erosion along the Sacramento River

In the spirit of cooperation, DWR, the Board, USACE, local maintaining agencies, and key federal and State resources agencies, have been engaged in California Levees Roundtable discussions since August 2007. Early discussions regarding ways to address USACE's levee vegetation policy led to the *California's Central Valley Flood System Improvement Framework* (Framework Agreement), dated February 27, 2009. The Framework Agreement allows Central Valley levees to retain acceptable maintenance ratings and Public Law 84-99 rehabilitation eligibility as long as levee trees and shrubs are properly trimmed and spaced to allow for visibility, inspection vehicles, and floodfight access. The Framework Agreement states that "…the eligibility criteria will be reconsidered based on the contents of the CVFPP."

While the California Levees Roundtable discussions were underway, USACE issued Engineering Technical Letter (ETL) 1110-2-571, which finalized its *Guidelines for Landscape Planting and Vegetation Management at Levees, Floodwalls, Embankment Dams, and Appurtenant Structures* (April 10, 2009). These guidelines essentially established a woody vegetation-free zone on all levees and the adjoining ground within 15 feet of the levee on both sides, and are at odds with DWR's independent assessment described above. As an implementation directive for the ETL, USACE subsequently issued a draft Policy Guidance Letter (PGL), *Variance from Vegetation Standards for Levees and Floodwalls* (February 9, 2010). Congress, through the Water Resources Development Act of 1996, Section 202 (g), had mandated that USACE "address regional variations in levee management and resource needs" – but the February 2010 draft PGL did not address regional variations.

Before and following release of the draft PGL, DWR has recommended that USACE formulate a variance process that is workable on a systemwide scale, such as might be required for the Central Valley flood management system. DWR has recommended that such a variance process should allow for consideration of the geotechnical, hydraulic, environmental, and economic factors that DWR believes are important in formulating and prioritizing levee repairs and improvements. Because the February 2010 draft PGL was not workable from DWR's perspective, in May 2011, DWR proposed an alternative variance procedure for USACE consideration. Although USACE has stated their procedural inability to work individually with California (or collectively with several non-federal entities) to collaboratively develop a variance policy that recognizes and accommodates regional differences, DWR remains hopeful that USACE will issue a final vegetation variance PGL that will complement and be consistent with the CVFPP.

It is important to note that the large-scale removal of levee vegetation runs at odds with State and federal environmental requirements. State and federal resource agencies find that the ETL itself, and the potential impacts of widespread vegetation removal due to strict enforcement of that regulation, pose a major threat to fish and wildlife species, including protected species, and to their recovery. Similarly, local agencies are concerned about negative impacts to public safety from ETL compliance due to redirection of limited financial resources to lower priority risks. For this reason, widespread vegetation removal is unlikely to be a feasible management action for many of California's levees.

A further complication is the question of shared responsibility for activities to address woody vegetation. The USACE ETL and associated February 2010 draft PGL do not recognize that legacy levee vegetation exists for a wide variety of reasons (in many cases, because USACE itself placed the vegetation or encouraged its placement or retention), and instead treats all legacy levee vegetation as if it were "deferred maintenance" and solely a nonfederal responsibility. Consequently, USACE asserts through the ETL and draft PGL that all of the administrative and financial burdens for ETL compliance, or for obtaining a variance, should be placed on its nonfederal partners. The State continues to encourage USACE to accept shared responsibility for addressing levee vegetation issues, as appropriate – which would also facilitate USACE plan formulation as a partner in cost-shared flood risk reduction projects.

It is important to note that DWR's purpose in advocating for shared responsibility is not to commit federal funds toward the enormous cost of removing vegetation to achieve ETL compliance. Rather, DWR is advocating that such inordinate costs be avoided by having USACE partner with DWR, the Board, and local agencies in addressing legacy levee vegetation issues, jointly considering the environmental and risk reduction implications of vegetation remediation within the context of prudent expenditure of limited public funds. DWR will continue to confer with USACE on plan formulation concepts that recognize shared responsibility for addressing vegetation issues (in parallel with traditional levee risk factors) within a systemwide risk-informed context that is intended to enable critical cost-shared flood system improvements to move forward.

A critical limitation of the USACE ETL is that it is written strictly in terms of new levee construction. It does not recognize and address the unique engineering and environmental attributes presented by well-established "legacy vegetation" as an integral aspect of many SPFC levees. While the CVFPP proposes to adhere to USACE vegetation policy for new levee construction, compatibility of the CVFPP levee vegetation management strategy with implementation of USACE national vegetation policy for "legacy levee vegetation" needs flexibility to recognize and accommodate regional differences – which could be achieved through a collaboratively developed variance policy that provides such regional flexibility.

8.10.2 Economics of Public Law 84-99 Eligibility for Rural-Agricultural Levees

Noncompliance with USACE vegetation policy may result in Public Law 84-99 ineligibility for rural-agricultural levees. However, compliance with the policy is costly and generally is not affordable for rural-agricultural maintaining agencies, nor is it practicable. Although the Public Law 84-99 Rehabilitation and Inspection Program can be helpful to nonfederal sponsors in rehabilitating damaged levees after a flood, its usefulness is limited in the Central Valley for the following reasons:

- Funding for Public Law 84-99 rehabilitation assistance is generally very limited. Public Law 84-99 rehabilitation assistance for significant damage repairs usually requires a special appropriation by Congress.
- There is no mechanism to obtain reimbursement or credit when a nonfederal sponsor performs the repairs, or pays USACE to perform the repairs.
- Increasingly stringent USACE maintenance requirements, especially for encroachments and vegetation, can be difficult to meet and are unaffordable.

- Rehabilitation projects need to be economically justified with a benefit-to-cost ratio of 1.0 or greater to justify federal involvement. In rural-agricultural areas of the Sacramento and San Joaquin river basins, this requirement can be difficult to achieve.

From a nonfederal perspective, the most critical concerns about implementing the USACE vegetation policy are the environmental impacts, the cost to comply with the policy, and the misallocation of scarce public funds for system improvement.

Based on USACE expenditures under Public Law 84-99 for declared flood events in 1995, 1997, 1998, and 2006, the preliminary estimate of annualized assistance of levee rehabilitation is approximately $30 million. This estimate is significantly influenced by the $120 million in assistance provided by USACE following the 1997 flood event – an amount not likely to be duplicated based on subsequent changes in USACE policy, such as their levee vegetation policy.

In April 2010, DWR developed a Fiscal Impact Report of the U.S. Army Corps of Engineers' Vegetation Management Standards and Vegetation Variance Policy for Levees and Flood Walls. This report includes the cost estimates of applying the ETL to the 116 critical levee repairs performed from 2006 through 2008 and the cost estimate of applying the ETL to the entire 1,600 miles of project levee system by extrapolation. The estimated order of magnitude cost to comply with the USACE policy ranged from $6.5 billion to $7.5 billion. Annualizing this cost of compliance (over a 50-year project life at 6 percent) would yield an annual cost of over $400 million, more than ten times the $30 million annual assistance estimated above.

Therefore, the State interest is to follow the vegetation management strategy presented in CVFPP Section 4. The local maintaining agencies may choose to comply with the USACE vegetation policy to maintain Public Law 84-99 eligibility; however, it would be very challenging for rural-agricultural maintaining agencies because of cost of compliance for eligibility. This is evident by the results of USACE periodic inspections. As of fall 2011, 39 of 116 local maintaining agencies have lost eligibility for Public Law 84-99 rehabilitation assistance for reasons other than vegetation.

Since the actual expenditure of Public Law 84-99 funds is based on unit-specific determinations of federal interest, removal of levee systems from "active status" eligibility under Public Law 84-99 based on noncompliant vegetation would be unnecessary since USACE Engineering Regulation 500-1-1 protects the federal government from bearing any of the cost of any levee rehabilitation work associated with "deferred or deficient maintenance." While the State does not consider much of the noncompliant vegetation on the levees as "deferred or deficient maintenance," the USACE may use this regulation to justify retention of levees with noncompliant vegetation in "active status" in order to protect the federal investment in SPFC levees. In cases where the site-specific Project Information Report determines that noncompliant vegetation contributed to levee damage and/or increased rehabilitation costs, USACE may assign incremental costs attributed to such vegetation to the nonfederal partner.

8.11 Residual Risk Management

As elements of the SSIA are constructed over time, residual flood risk within the Central Valley should decrease. However, the potential for flooding in the Central Valley will always pose risks to life and property, particularly in areas of deep or rapid flooding. Table 8-5 illustrates estimated residual risk management needs for the SSIA. These can be compared with the residual risk needs estimated for the preliminary approaches.

Consequently, investments in residual risk management must continue, both during and after implementation of the SSIA. Policies and programs related to residual risk management are described in more detail in CVFPP Section 4.

Table 8-6 summarizes the preliminary estimate of costs for the SSIA, assuming all elements are ultimately completed. Estimates include costs for capital improvements and 25 years of ongoing annual work to maintain the system. Estimated costs are in 2011 dollars. Actual costs will vary from those in Table 8-5 because of a wide range of factors, including project justification by feasibility studies, project configuration, implementation time, future economic and contractor bidding conditions, and many others.

Specific project features ultimately implemented for the SSIA will depend on a host of factors. These factors include detailed project feasibility studies; cost estimates; environmental benefits and impacts; interaction with other local projects and system improvements; local, federal, and State agency participation in project implementation; and changing physical, institutional, and economic conditions.

Table 8-5. Residual Risk Management for State Systemwide Investment Approach

Flood Management Element	Project Location or Required Components	Included in SSIA Implementation
Enhanced Flood Emergency Response	All-weather roads on levee crown	YES
	Flood information collection and sharing	YES
	Local flood emergency response planning	YES
	Forecasting and notification	YES
	Rural post-flood recovery assistance program	YES (Small)
Enhanced Operations and Maintenance	Identifying and repairing after-event erosion	YES
	Developing and implementing enhanced O&M programs and regional O&M organizations	YES
	Sacramento channel and levee management, and bank protection	YES
Floodplain Management	Raising and waterproofing structures and building berms	YES (Large)
	Purchasing and relocating homes in floodplains	YES (Large)
	Land use and floodplain management	YES
	Agricultural conservation easements	YES

Key:
Large = relatively high level of work to implement
O&M = operations and maintenance
Small = relatively low level of work to implement
SSIA = State Systemwide Investment Approach

8.12 Estimated Cost of State Systemwide Investment Approach

The table also includes SPFC flood management investments that have already been expended or committed during the 2007 to 2011 period. Since passage of the 2007 flood legislation directing preparation of the 2012 CVFPP, the State has made substantial progress in reducing flood risks within the Central Valley by investing bond funds from Propositions 84 and 1E. These efforts encompass urban levee improvements, emergency repair projects, physical and operational changes to flood management reservoirs, emergency response planning, and improvements to operations and maintenance, emergency response, and floodplain management. These accomplishments over the past five years represent significant progress in achieving the 2012 CVFPP Goals.

The estimated amounts in Table 8-6 are total combined investments for State, federal, and local agencies. CVFPP Section 4 provides further detail on cost-sharing proportions, and expenditures prior to adoption of the 2012 CVFPP. Consistent with traditional cost-sharing for flood management projects, DWR estimates that the State's share of costs included in Table 8-6 will be $6,400 million to $7,700 million, including already expended or committed investments, if all elements of the SSIA are ultimately constructed. CVFPP Section 4 also shows cost estimates over a more certain time period of 10 years that will allow near-term projects to be constructed as longer term projects are under additional evaluation.

State Investments in State Plan of Flood Control Flood Management, 2007 – 2011

Flood Emergency Response

- *Emergency exercises*
- *New water gaging*
- *Forecast-Coordinated Operations for Yuba/Feather*
- *Rock stockpiles in Delta*

Operations and Maintenance

- *Over 220 levee sites repaired*
- *Sediment removal from bypasses*
- *Rehabilitation of 7 flood structures*

Floodplain Management

- *Approved building code amendment for single family residential occupancy*
- *300,000 flood risk notifications annually, between 2010 and 2011*
- *Mapping of Central Valley Levee Flood Protection Zones*

Capital Improvements

- *15 ongoing or completed projects*

Assessments and Engineering

- *9,000 square miles of topographic data*
- *Urban and nonurban levee evaluations*
- *State Plan of Flood Control Descriptive Document*
- *Flood Control System Status Report*
- *CVFPP development*
- *Coordination with USACE on many ongoing evaluations*

Ecosystem

- *See 2012 CVFPP Section 4 for ecosystem accomplishments*

Table 8-6. Estimated Costs for State Systemwide Investment Approach ($ Millions)

	System Improvements			Urban Improvements			Rural-Agricultural Improvements			Residual Risk Management			Total Cost		
Region	**Low**		**High**	**Low**		**High**	**Low**		**High**	**Low**		**High**	**Low**		**High**
1 – Upper Sacramento	$109	-	$180	$120	-	$144	$154	-	$168	$95	-	$114	$480	-	$610
2 – Mid-Sacramento	$234	-	$340	$0	-	$0	$360	-	$379	$261	-	$333	$860	-	$1,050
3 – Feather River	$1,695	-	$2,139	$891	-	$1,048	$282	-	$289	$170	-	$212	$3,040	-	$3,690
4 – Lower Sacramento	$1,627	-	$1,962	$3,549	-	$4,283	$77	-	$88	$138	-	$169	$5,390	-	$6,500
5 – Delta North[1]	$754	-	$924	$144	-	$192	$604	-	$634	$266	-	$311	$1,770	-	$2,060
6 – Delta South[1]	$427	-	$549	$0	-	$0	$47	-	$52	$110	-	$135	$580	-	$740
7 – Lower San Joaquin	$7	-	$8	$626	-	$809	$17	-	$19	$82	-	$97	$730	-	$930
8 – Mid-San Joaquin	$60	-	$102	$0	-	$0	$48	-	$55	$81	-	$96	$190	-	$250
9 – Upper San Joaquin	$229	-	$297	$166	-	$199	$183	-	$189	$308	-	$396	$890	-	$1,080
TOTAL	**$5,140**	**to**	**$6,500**	**$5,500**	**to**	**$6,680**	**$1,770**	**to**	**$1,870**	**$1,510**	**to**	**$1,860**	**$13,920**	**to**	**$16,910**

Notes:
[1] SPFC Facility costs only
Costs in $ millions. All estimates in 2011 dollars.

Key:
SPFC = State Plan of Flood Control

8.13 Performance of State Systemwide Investment Approach

Based on the evaluations, the SSIA could effectively improve management of flood risk for urban, small community, and rural-agricultural areas given differing population, assets at risk, and other State interests. The SSIA reflects a cost-justifiable approach to effectively meet the legislation requirements and the 2012 CVFPP Goals, and provides a road-map for more detailed studies and designs leading to site-specific capital improvements.

The following sections summarize the additional performance benefits that could be achieved through implementing the SSIA. The following sections compare the performance of the SSIA to current conditions for several key parameters: changes in flood stage, sustainability, contributions to the 2012 CVFPP Goals, and relative efficiency. For analysis purposes, the current or No Project condition represents conditions consistent with the Notice of Preparation for the PEIR. It is also important to note that EIP projects and other FloodSAFE initiatives implemented since bond funding became available in 2007, which are considered part of the SSIA, have already provided benefits and are not reflected in this analysis.

8.13.1 Primary Goal Indicators

As discussed in Section 7.6.2, system performance indicators demonstrate how well each approach meets the primary goal of the 2012 CVFPP to improve flood risk management. Primary goal indicators include life risk, EAD, level of protection, and changes in peak flow.

Life Risk

Table 8-7 displays the percent reductions in life risk results for the Sacramento and San Joaquin river basins and Stockton area, and all approaches studied, compared to No Project. All of the approaches reduce life risk compared to No Project, with the greatest reduction attributable to Enhance Flood System Capacity Approach.

The life risk values are *conditional*: they represent consequences for a given area with a specified set of hydrologic and hydraulic conditions for the system, with best representation of performance of system levees and other features, and with stated assumptions regarding public warning and response. As such, the results are informative indices of life risk, and the values shown herein provide a reliable metric for comparing the life risk reduction attributable to the proposed 2012 CVFPP approaches.

Details on how life risk values were calculated can be found in the 2012 CVFPP Supporting Documentation – Technical Documentation Attachment 8G: Life Risk Analysis.

Table 8-7. Percent Reduction in Life Risk Values: Sacramento and San Joaquin River Basins

CVFPP Approaches	Sacramento River Basin (Percent Reduction)	San Joaquin River Basin (Percent Reduction)	Stockton Area (Percent Reduction)	Total (Percent Reduction)
No Project	58.6	4.1	1.4	64.1
Achieve SPFC Design Capacity	56.0	4.0	0.2	60.2
Protect High Risk Communities	31.6	3.9	0.2	35.6
Enhance Flood System Capacity	23.2	2.0	0.2	25.4
State Systemwide Investment	28.1	3.9	0.2	32.2

Key:
CVFPP = Central Valley Flood Protection Plan
SPFC = State Plan of Flood Control

Economic Damages

Economic damages from a flood event indicate the performance of the flood management system. Figures 8-4 and 8-5 present the annual structure, crop and business losses for the Sacramento and San Joaquin River Basins for the SSIA compared to No Project and each three preliminary approaches. Economic damages are shown in millions of dollars per year.

In the Sacramento Basin, the general trend shows that the SSIA would reduce annual structure, crop, and business damages compared to No Project (Figure 8-4), with regional variation shown in Figure 8-5. The SSIA would also reduce damages compared to the Achieve SPFC Design Flow Capacity and Protect High Risk Communities Approach, but not as much as the Enhance Flood System Capacity Approach.

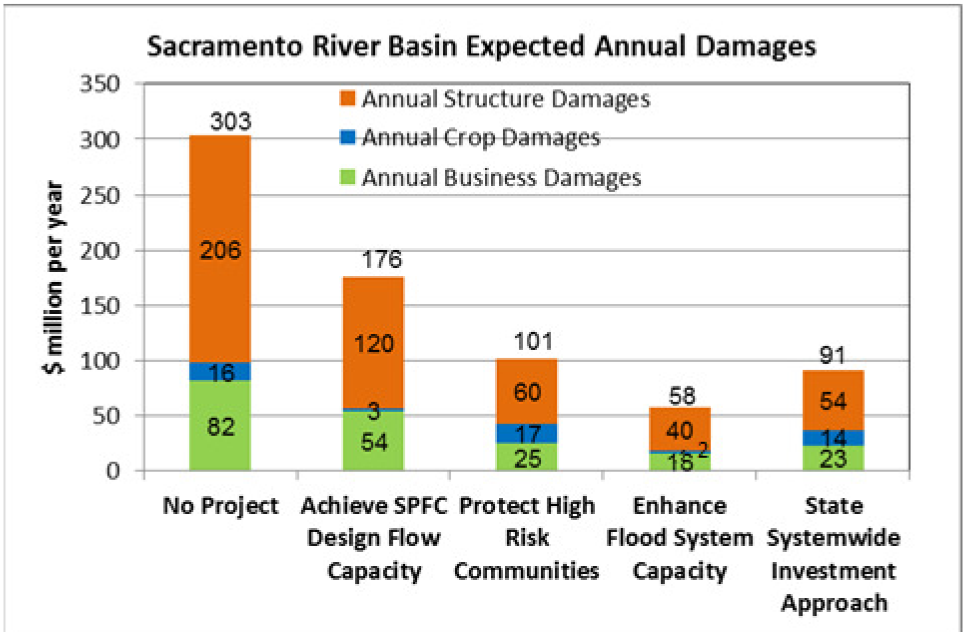


Figure 8-4. Summary of Potential Annual Direct Impacts of Flooding in the Sacramento Basin

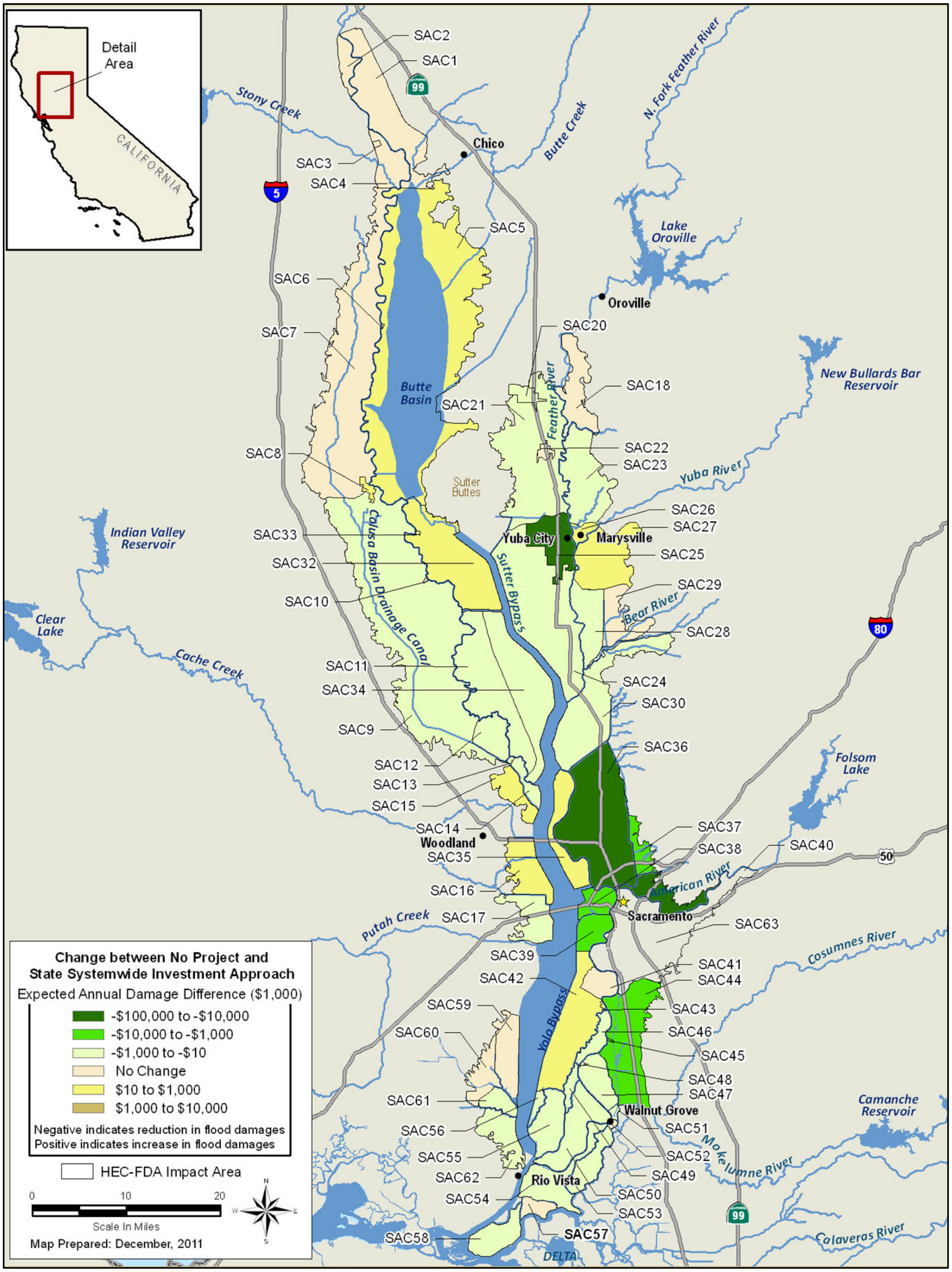


Figure 8-5. Summary of Potential Annual Direct Impacts of Flooding in the Sacramento Basin

In the San Joaquin River Basin, the general trend shows that the SSIA would reduce annual structure damages relative to No Project (Figure 8-6), with regional variation shown in Figure 8-7. Annual business losses would remain unchanged from No Project by the SSIA and preliminary approaches. Annual crop damages would remain unchanged by the SSIA or Protect High Risk Communities Approach, but would be reduced by the Achieve SPFC Design Flow capacity and the Enhance Flood System Capacity Approaches. This is because although cities and towns are protected under the SSIA, agricultural lands do not receive an increased level of protection.

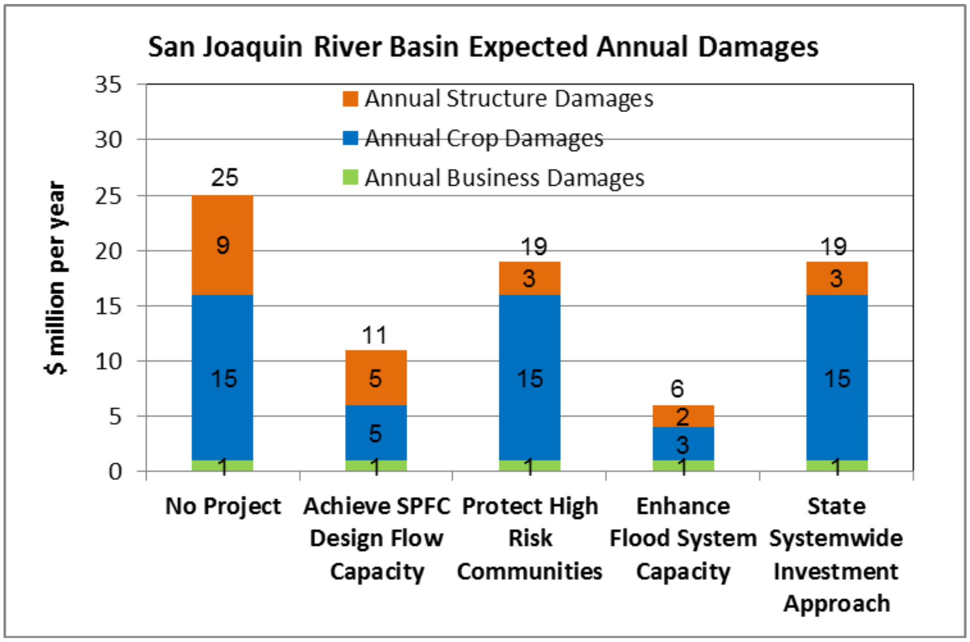


Figure 8-6. Summary of Potential Annual Direct Impacts of Flooding in the San Joaquin River Basin

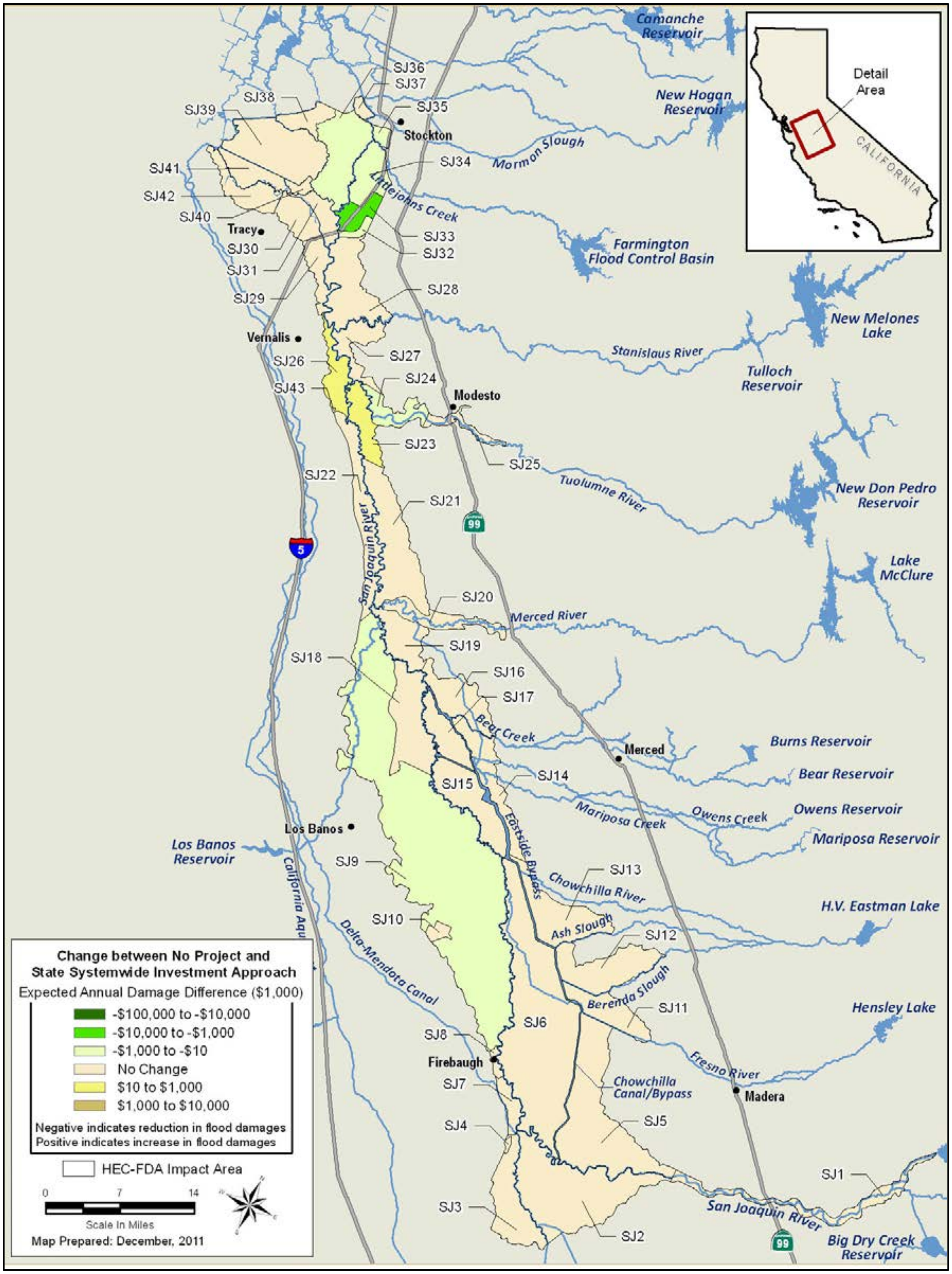


Figure 8-7. Summary of Potential Annual Direct Impacts of Flooding in the San Joaquin River Basin

Level of Protection

Figures 8-8 and 8-9 show the populations in the Sacramento and San Joaquin Basins and the LOP afforded to them under No Project, the SSIA, and each preliminary approach. All of the preliminary approaches showed an increase in the percentage of populations that are protected from the 0.5 or 1 percent AEP flood versus No Project with the greatest LOP for the greatest population occurring under the Enhanced Flood System Capacity Approach.

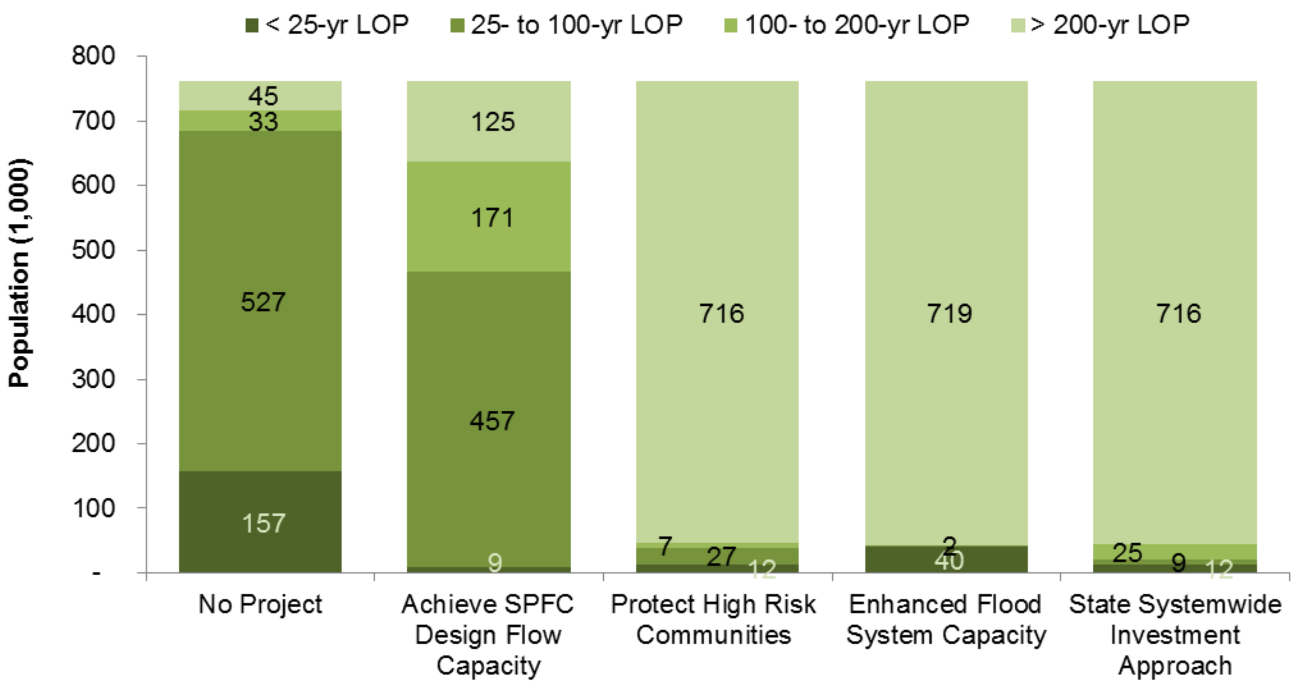


Figure 8-8. Protection for Population in Sacramento River Basin

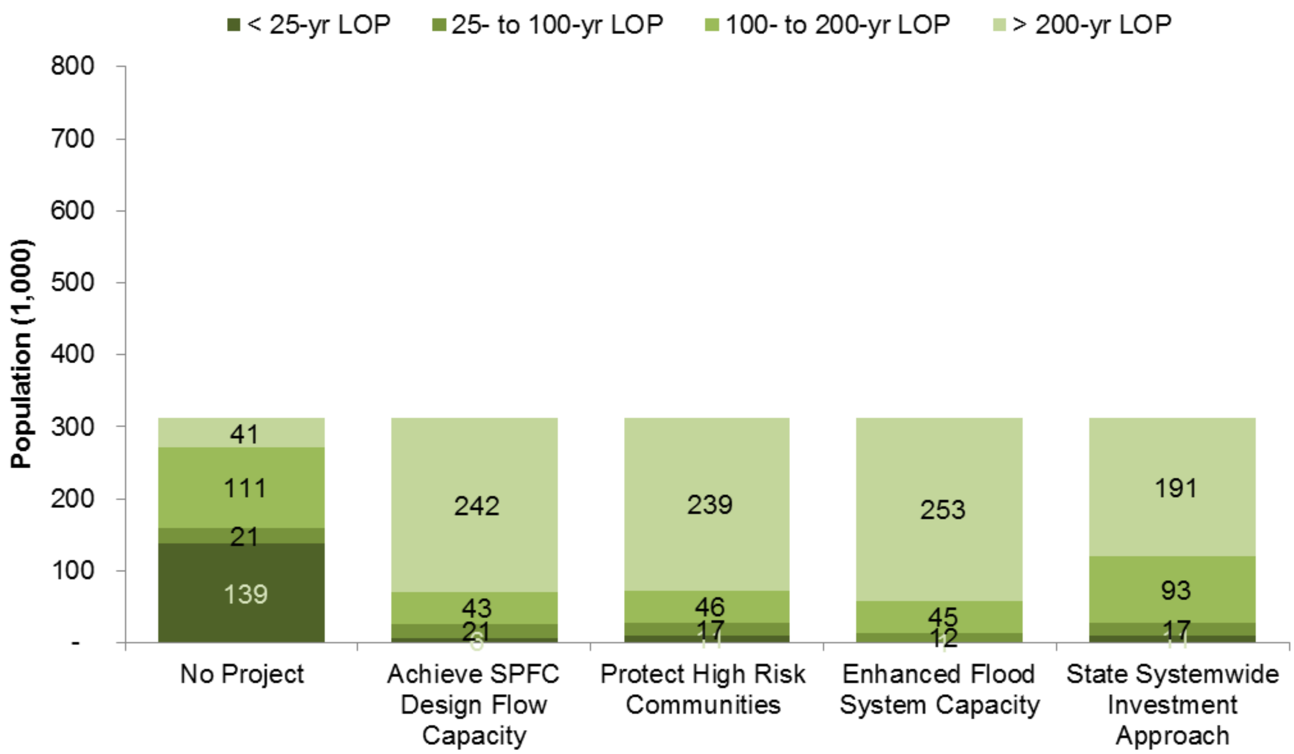
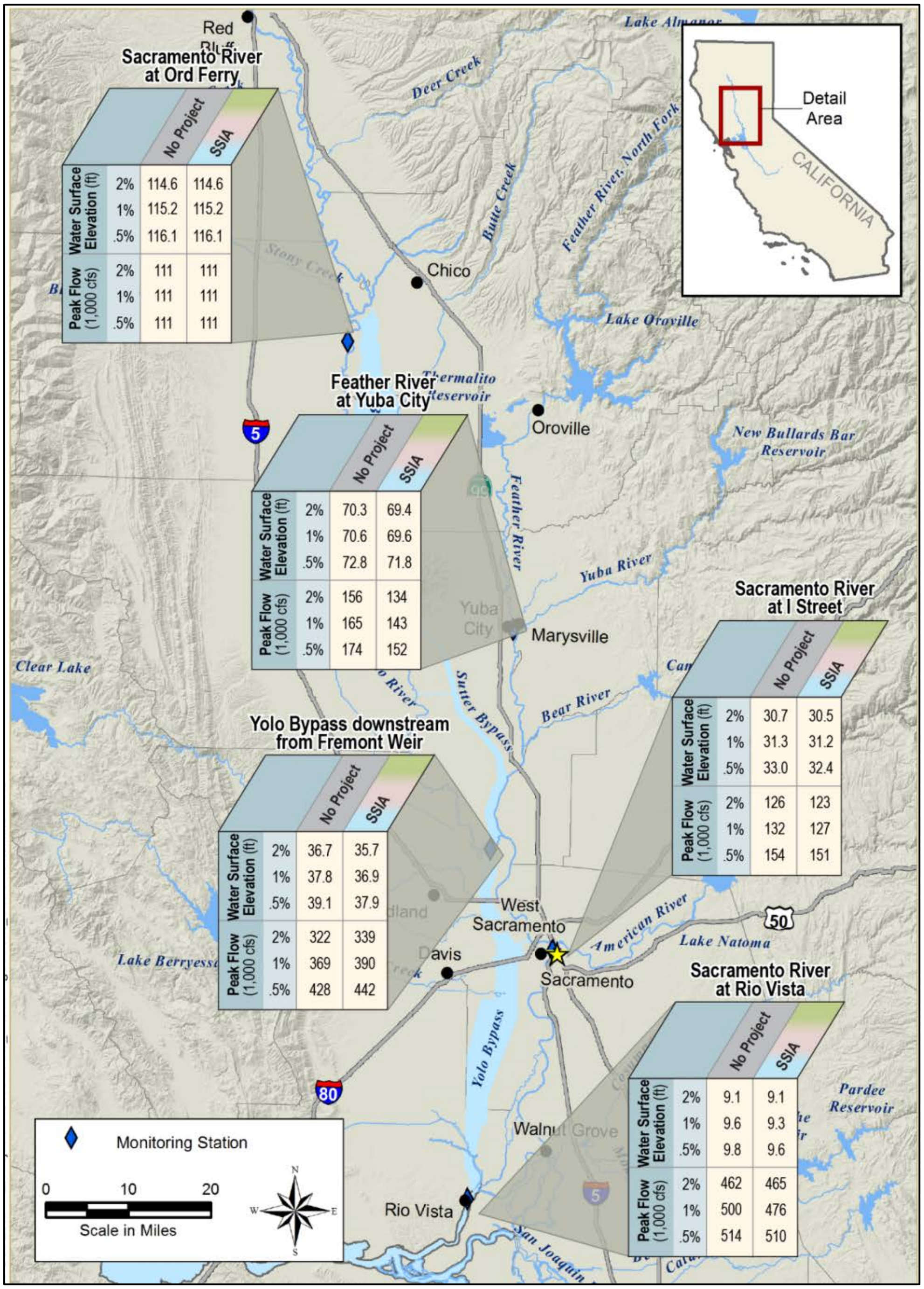


Figure 8-9. Protection for Population in San Joaquin River Basin

Stage Changes

Figures 8-10 and 8-11 illustrate performance of the SSIA with respect to systemwide peak floodwater surface elevations (stages) compared to current conditions. In most areas along the rivers in the Sacramento River Basin, stages are lower than current conditions because of the proposed bypass expansions. Flood stages in the San Joaquin River Basin would not change much with respect to current conditions because large bypass expansions were not included, except near the Delta. Flood stages entering the Delta may be higher by a few tenths of a foot. If stage changes result in significant hydraulic impacts, features to mitigate the impacts may be used.

Sequencing improvements along the river corridors may cause temporary water stage impacts and or hydraulic impacts. Sequencing improvements from downstream to upstream may eliminate these temporary impacts, but may not be practical considering the wide range of improvements that need to be made.

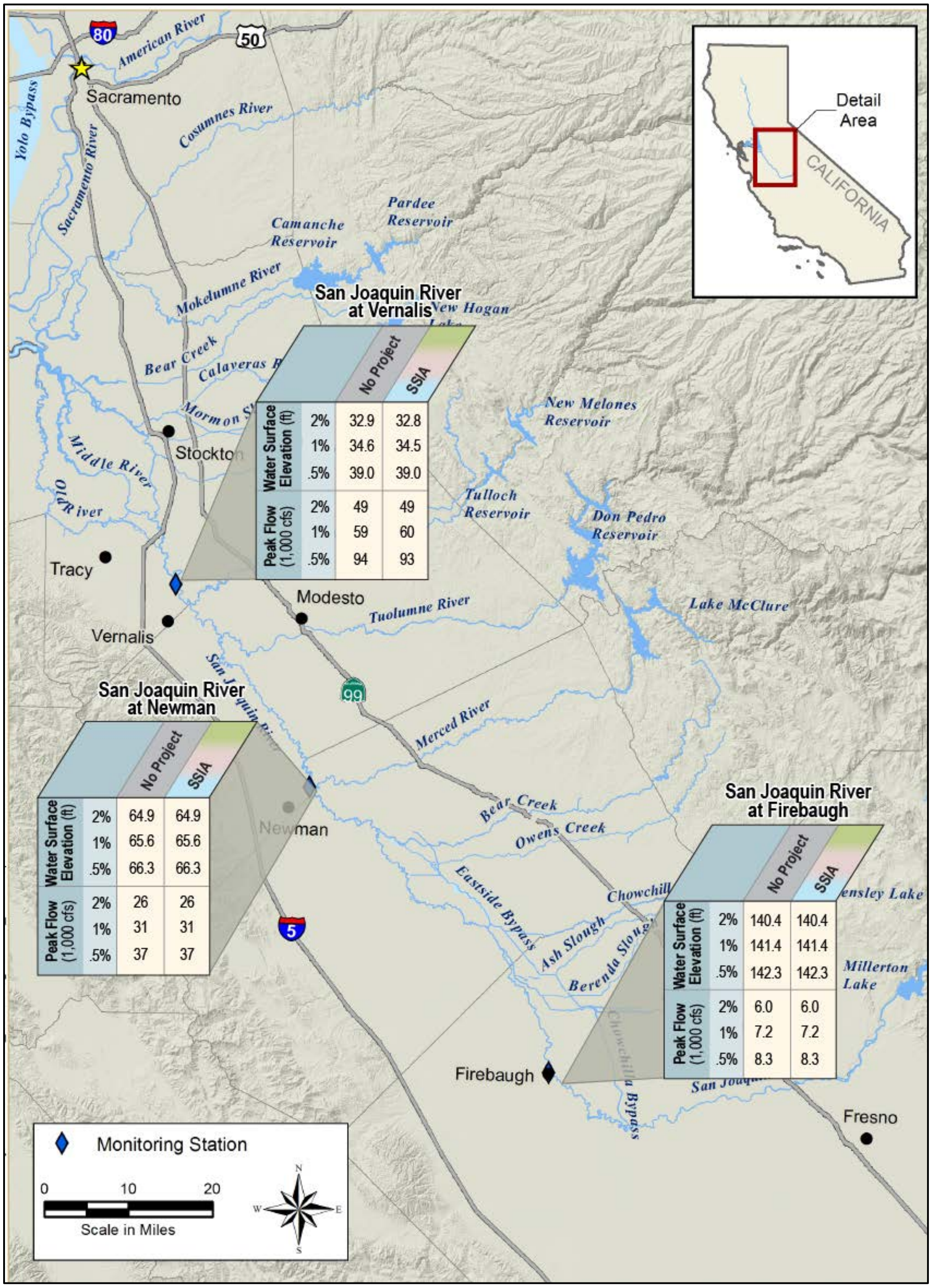


Note: Figure presents peak flow and water surface elevation estimates for various frequency flood events (represented as percent chance exceedence, e.g., 1%) at selected monitoring locations in the Sacramento River Basin.

Key:

cfs = cubic feet per second ft = feet SSIA = State Systemwide Investment Approach

Figure 8-10. Changes in Peak Floodflows and Stages – No Project Versus State Systemwide Investment Approach for Various Storm Events – Sacramento River Basin



Note: Figure presents peak flow and water surface elevation estimates for various frequency flood events (represented as percent chance exceedence, e.g., 1%) at selected monitoring locations in the San Joaquin River Basin.

Key: cfs = cubic feet per second ft = feet SSIA = State Systemwide Investment Approach

Figure 8-11. Changes in Peak Floodflows and Stages – No Project Versus State Systemwide Investment Approach for Various Storm Events – San Joaquin River Basin

8.13.2 Sustainability

Table 8-8 summarizes the financial, environmental, and social sustainability aspects of the SSIA compared with No Project.

Table 8-8. Summary of State Systemwide Investment Approach Sustainability Compared with No Project

Overall Sustainability	No Project	State Systemwide Investment Approach
	Low	**Medium**
Financial	Very high ongoing and long-term annual costs	Very high upfront and lower long-term annual costs.
Environmental	Limited opportunities to improve habitat connectivity, quality, quantity, and biodiversity	Enhanced opportunities to improve habitat connectivity, quality, quantity, and biodiversity.
Social	Varied level of protection throughout the system Significant potential for public safety and economic consequences of flooding	Seeks flood protection comparable with assets being protected. Limits cumulative growth of flood risks to State's people and infrastructure due to system improvements. Reduces reliance on compensatory mitigation for project implementation and regular operations and maintenance due to implementation of systemwide conservation strategy. Rebalances institutional arrangement for operations and maintenance responsibilities.
Climate Change Adaptability	Low system resiliency (ability to adapt)	Conveyance improves flood system resiliency by lowering stages, which improves ability to adapt to climate change.

Key:
State = State of California

8.13.3 Central Valley Flood Protection Plan Goals

Table 8-9 summarizes contributions of the SSIA to the five 2012 CVFPP Goals, compared with No Project.

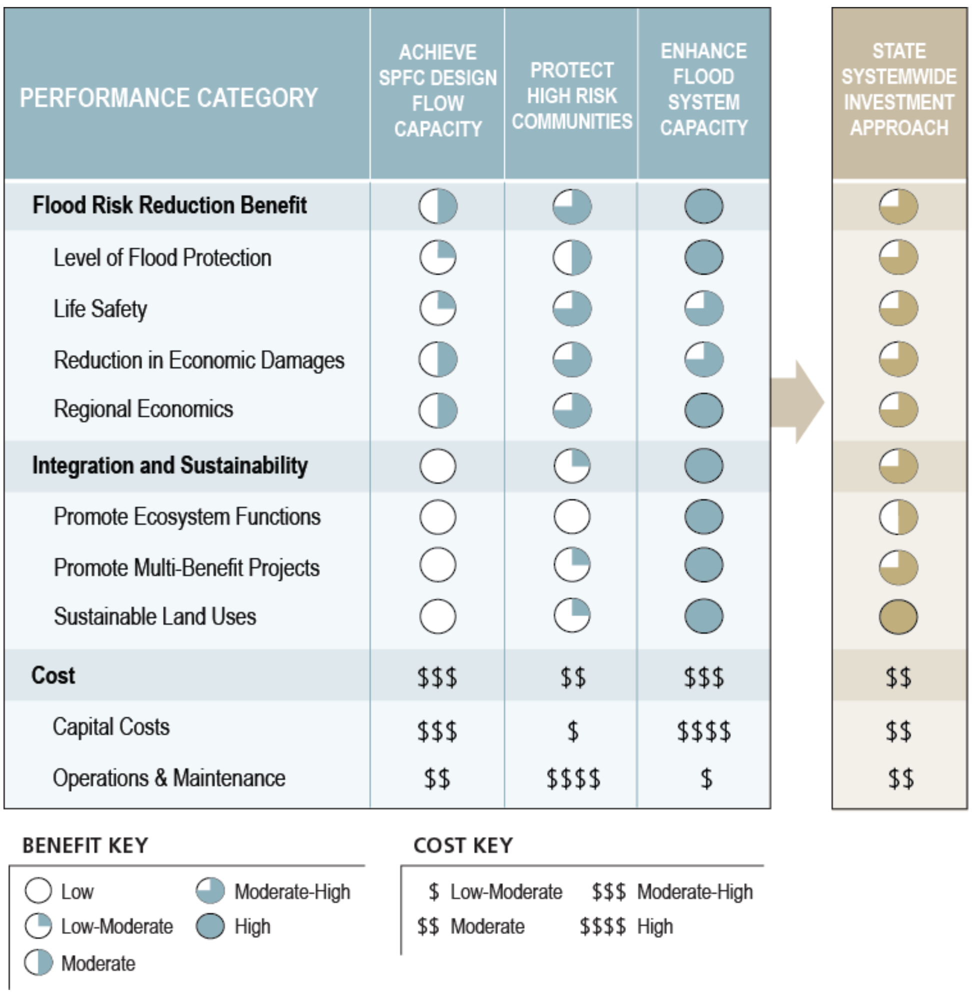
Table 8-9. Summary of Contributions of State Systemwide Investment Approach to Central Valley Flood Protection Plan Goals Compared with No Project

Goal or Metric	No Project	State Systemwide Investment Approach
Contributions to Primary Goal – Improve Flood Risk Management		
Level of Flood Protection	**Varies throughout system** • Most urban areas do not have 200-year level of flood protection • Protection to rural-agricultural areas and small communities varies widely	**Overall higher protection consistent with assets being protected** • Urban areas achieve protection from a 200-year flood, and for small communities achieve protection from a 100-year flood • Overall increased levels of flood protection throughout the system reflecting improved capacity to manage flood peaks
Life Safety (focused on populations at risk)	**Varies throughout system** • Public safety threat is high for many communities, particularly those in deep floodplains	**Improvement varies** • Substantial improvement in urban areas • Improvement in small communities varies
Economic Damages	**$329 million in expected annual damages** • Economic damages, particularly in urban areas, are very high	**Reduction of 66 percent in expected annual damages** • Substantial reduction in damages in urban areas, small communities, and rural areas
Contributions to Supporting Goals		
Improve Operations and Maintenance	**Very high current costs** • Ongoing and long-term O&M costs are very high relative to other approaches	**Decrease in long-term O&M requirements** • Decrease in long-term costs due to O&M reforms (clarified roles and responsibilities, consistent standards, and revenue generation improvements) and physical modification to reduce geomorphic stressors
Promote Ecosystem Functions	**Limited opportunities for ecosystem benefit** • Native habitat may be integrated into SPFC repair projects, primarily through mitigation	**Enhanced opportunities for systemwide ecosystem benefit** • Floodway expansion provides substantial opportunity to improve ecosystem functions, fish passage, and the quantity, quality, and diversity of natural habitats
Improve Institutional Support	• **Continued dispersion of responsibilities and roles** for flood management in the Central Valley among many agencies with varying functions and priorities	• **Improve flood management functions** through changes and/or clarifications in current State policy directives, legislated authority and responsibilities, and partnerships with federal and local partners
Promote Multi-Benefit Projects	• **Limited opportunities** to integrate other benefits into repairs to SPFC facilities	• **Enhanced opportunities** to integrate water quality, groundwater recharge, recreation, power, and other benefits
Ability to Meet Legislative Objectives (Completeness)		
Ability to Meet Objectives in Flood Legislation	**Does not meet** • Varied level of protection throughout the system and high potential for public safety and economic damages	**Addresses all objectives** • Contributes to all objectives with proposed system and regional elements, and supporting implementation policies and programs

Key:
O&M = operations and maintenance
SPFC = State Plan of Flood Control
State = State of California

8.13.4 Relative Efficiency

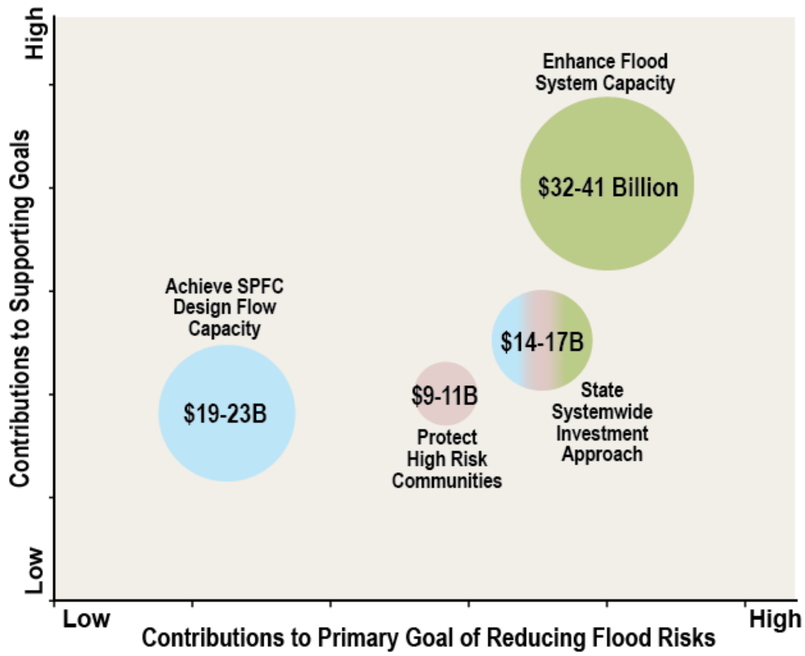
DWR prepared the qualitative comparison to show the broad differences in potential performance of the preliminary approaches and the SSIA. Figure 8-12 shows qualitative comparisons of performance for SSIA with the three preliminary approaches. These comparisons are the same as shown in Section 7, but with the addition of the SSIA.



Key: SPFC = State Plan of Flood Control

Figure 8-12. Performance Comparison for All Approaches

Another view of the relative performance of the three preliminary approaches and SSIA is shown in Figure 8-13. The figure shows preliminary cost estimates and estimated performance in terms of the relative contributions of each approach to the primary and supporting goals of the 2012 CVFPP.



Key:
B = Billion
SPFC = State Plan of Flood Control

Figure 8-13. Relative Comparison of State Systemwide Investment Approach and Preliminary Approach Efficiency

8.14 State Systemwide Investment Approach Benefits

The SSIA, as a multi-benefit and integrated flood management approach, has many direct and indirect benefits to the Central Valley, State, and nation. This section summarizes the benefits of the SSIA.

Benefits assessed include reduced economic damages, benefits to local and regional economies, improved public health and safety, ecosystem restoration, open space and recreation, increased flood system resiliency and climate change adaptability, water management, and reduced long-term flood system management costs. Some of these benefits are presented quantitatively and some qualitatively, because some of the benefits could not be calculated at this time. These benefits will be further refined and documented during the feasibility study process scheduled to be initiated upon adoption of the 2012 CVFPP by the Board.

8.14.1 Reduced Economic Flood Damages

The USACE Hydrologic Engineering Center Flood Damage Analysis (HEC-FDA) model was used to estimate the flood risk reduction benefits of the SSIA. Expected annual flood damages were computed over the array of potential floods, from small to extremely large, compared with the no project condition. The flood damage estimates consider the following:

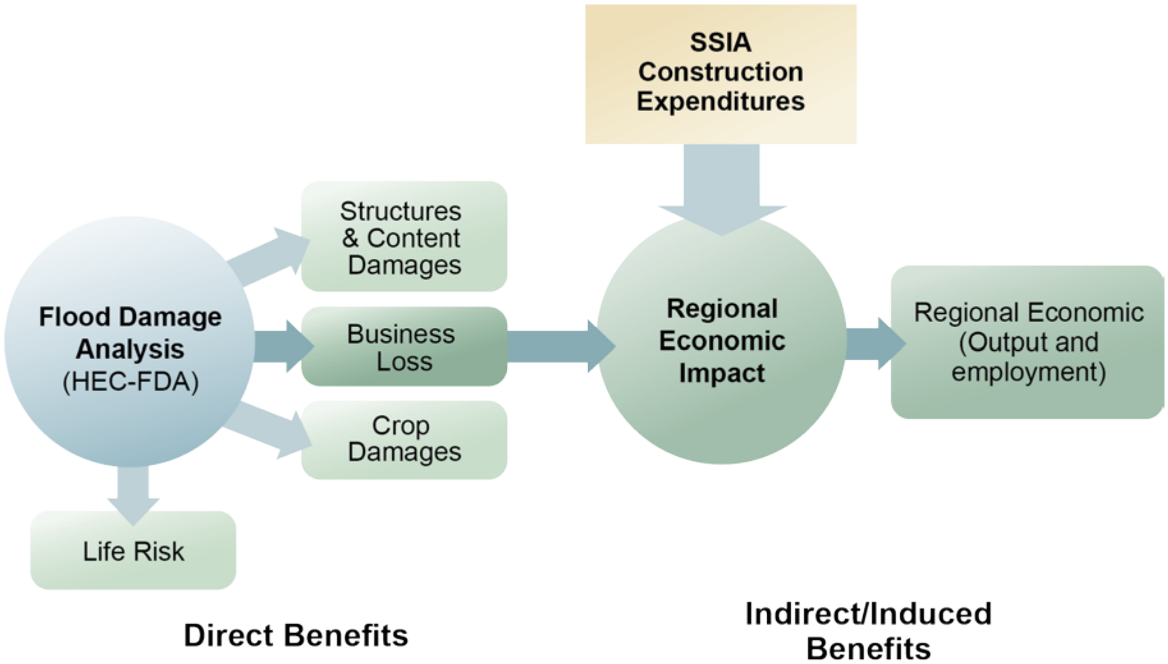
- Residential, commercial, industrial, and governmental structure and contents damage
- Agricultural/crop losses
- Business production losses

Results of the modeling indicate an overall reduction in total expected annual damages of about 66 percent, with specific reductions in damages and losses as follows:

- Structure and contents flood damages would be reduced by 73 percent
- Crop damages due to flooding would be reduced by 6 percent
- Business production losses would be reduced by 71 percent

8.14.2 Benefits to Local and Regional Economies

Reduction in flood damages is only one aspect of the potential economic benefits of the SSIA. As illustrated in Figure 8-14, flood risk reduction improvements can also provide both direct and indirect benefits to local, regional, and State economies. Additional details can be found in the 2012 CVFPP Attachment 8H: Regional Economic Analysis for the State Systemwide Investment Approach.



Key:
HEC-FDA = U.S. Army Corps of Engineers Hydrologic Engineer Center Flood Damage Analysis
SSIA = State Systemwide Investment Approach

Figure 8-14. Components of Economic Analysis

Implementation of the SSIA would contribute to local and regional economic activities, as described below:

- **Increased benefits to regional economies –** Implementing the SSIA would directly and indirectly benefit local and regional economies and support continued economic development in the valley. Implementation of the plan would reduce the potential for lost agricultural, commercial, and industrial production/income, and secondary "ripple" effects, as a result of a flood. Construction activities related to SSIA implementation could be expected to boost economic output over the coming decades by as much as $900 million, and avoided business losses due to flooding could increase long-term economic output by over $100 million. The potential for flood-induced industry relocation or failure to recover to preflood levels would also be reduced. In addition, construction projects resulting from implementation of the SSIA would be expected to boost regional short-term employment and employment incomes, and increase regional economic output. Construction activities in support of SSIA implementation could be expected to generate as many as 6,500 jobs annually over the coming decades, while reduced business losses from flooding could be expected to boost long-term employment. These employment economic benefits would also enhance the revenues of local governments through increased income and sales taxes.

- **Enhanced agricultural sustainability –** Central Valley agriculture is a critical sector of the State economy that provides and supports reliable, affordable food and fiber production, both domestically and on a global scale. Agricultural and associated processing industries and services also account for a considerable portion of local employment. Flood management improvements would reduce direct crop damages. Improved flood protection would result in an increased ability to obtain favorable crop insurance coverage and rates. Similarly, improved protection would also increase the ability to obtain agricultural loans with favorable terms. As a result, flood management improvement has the potential to contribute to improved agricultural sustainability. Over 90 percent of the citizens in rural-agricultural areas and small communities within the SPFC Planning Area could receive additional flood protection by levee improvement measures, flood proofing, and relocation opportunities presented in the SSIA.

- **Reduced disruption of public services –** In addition to reducing physical damages to structures and infrastructure, flood management improvements would reduce potential disruption of critical public services needed to maintain the health, safety, and welfare of the population. These critical functions include emergency services, transportation, health care, education, and public utilities (water and wastewater, electricity, natural gas, and communications). Interruption of these services and functions would greatly affect socioeconomic conditions in the region and its economic and industrial diversity. The 2012 CVFPP has not quantitatively assessed the loss of critical public services, but has estimated the number of critical facilities *exposed* to flood hazards.

8.14.3 Improved Public Health and Safety

A primary objective of the SSIA is to protect the citizens living and working in the floodplains of the Central Valley.

- **Reduced potential for injuries and loss of life –** When fully implemented, the SSIA would significantly reduce the potential for flooding in urban areas and other population centers, thereby reducing the direct threats posed by flooding to public safety, including the potential for injury or loss of life. Implementation of the SSIA would result in an increase in the population receiving at least a 100-year (1% annual chance) level of flood protection from the current 21 percent to over 90 percent. Additional reductions in the potential for loss of life would be achieved as a result of nonstructural flood mitigation, such as improved flood emergency response, operations and maintenance, and floodplain management measures.

HEC-FDA was used to estimate life risk indicators and inform the decision-making process. However, these values are NOT forecasts of *deaths* expected to occur from flood events, to be used for emergency planning or other purposes. Instead, these values are informative indices of life risk, providing a metric for assessing the reduction in life risk attributable to the SSIA. Based on the analysis, the SSIA was shown to reduce life risk by about 49 percent compared with current conditions.

The economic and life safety benefits for the SSIA described above do not include benefits attributable to projects that were recently completed or are currently under construction. Therefore, the overall benefits of the SSIA described herein are considerably underestimated.

- **Reduced release of hazardous materials during floods –** Floods can cause a release of hazardous materials resulting in increased threats to public health and safety. Hazardous materials and contaminants may exist in floodplains, including feed lots, fuel tanks, septic systems, water and wastewater treatment facilities, landfills, illegal dumping, and other sources. Improved flood management under the SSIA would contribute to reducing public exposure to hazardous materials released during floods and improve water quality by minimizing inundation to these critical areas.

8.14.4 Ecosystem Restoration Benefits

Ecosystem restoration is fully integrated with the flood risk reduction components of the SSIA. Major restoration benefits of the SSIA include the following:

- Floodways would be expanded and extended to improve the flow carrying capacity of the channels, and the lands acquired for the expansion would be used for habitat restoration and environmentally-friendly agricultural activities. Over 10,000 acres of new habitats would be created within the flood management system. In addition, over 25,000 acres of land would be leased for growing grains, corn, and other habitat-compatible crops. Flood management system improvements would provide opportunities for improving ecosystem function and increasing habitat extent, quantity, quality, and connectivity from the Delta to the upper Sacramento River. Expanded floodways would create space for river meandering, sediment erosion and deposition, natural ecosystem disturbance processes, and a healthy diversity of riverine habitat.

- The SSIA would improve fish passage at flood diversions, flashboard dams, and flood management structures. This includes connecting fishery habitat from the Delta to the Yolo and Sutter bypasses and to the Butte Basin. These actions would assist in increasing and improving habitat connectivity and promoting the recovery of anadromous fish populations.

- Changes in flood control facility operations, including directing flows more frequently and for longer durations over weirs and into bypasses, levee setbacks, and other similar measures planned under the SSIA, would enhance riverine processes and improve the overall health of the ecosystem.

Overall, these restoration activities would contribute to improving habitat connectivity along the flood management system, would provide for migration of fish to spawning areas in the watershed, and would enhance riverine processes.

8.14.5 Open Space and Recreational Opportunities

The State's interest in public health and sustainable economic growth are well supported by the quality of life benefits of nature-based recreation and the economic vitality provided by environmental tourism revenues. The potential for recreational use of the flood control system has long been recognized. In 1929, when the flood control system was under construction, noted landscape architect Frederick Law Olmstead Jr. recommended that a system of recreation lands be preserved within the leveed floodplains along the lower Sacramento River and other waterways.

The SSIA includes floodplain reconnection and floodway expansion, which would improve ecosystem functions, fish passage, and the quantity, quality, and diversity of natural habitats, all of which contribute to increasing opportunities for recreation and ecotourism, as well as augmenting the aesthetic values of those areas. Expansion of habitat areas provides fishing, hunting, and wildlife viewing opportunities. Recreation-related spending associated with increased use by visitors can be an important contributor to local and regional economies.

8.14.6 Increasing Flood System Resiliency and Climate Change Adaptability

Climate change is expected to result in more precipitation in the form of rainfall, more frequent flooding, and higher peak flows. Expansion and extension of the bypass system under the SSIA would reduce peak flood stages throughout the system, increasing the flood carrying capacity of channels and, hence, add flexibility to manage extreme flood events and future climate change effects.

8.14.7 Water Management Benefits

Effects of State Systemwide Investment Approach Implementation on Land Use

Preliminary analyses indicate that with implementation of the SSIA it is expected that:

- *100 percent of existing urban areas protected by SPFC facilities attain 200-year level of flood protection*
- *About 20 of the small communities in the SPFC Planning Area (from a total of 27) will attain 100-year level of flood protection, at a minimum. The rest of the small communities are expected to get flood protection through nonstructural means, including raising, flood proofing, and relocation of structures*
- *About 90 percent of residents in small communities within the SPFC Planning Area will receive at least 100-year flood protection*
- *In rural areas, the level of flood protection will increase slightly; in the Sacramento River Basin, rural areas receiving a 25-year or higher level of protection would increase by about 6 percent, while the San Joaquin River Basin will increase slightly*
- *About 10,000 acres of agricultural lands would be converted to environmental habitat restoration within the expansion of the bypass systems*

The SSIA, as an integrated flood and water management program, would provide opportunities for improved water management in many ways. While estimates of water management benefits will be quantified for the 2017 CVFPP, DWR expects that the average annual water management benefits of the SSIA may approach a few hundred thousand acre-feet compared to No Project. SSIA elements that could contribute to improved water management include reservoir operations and increases in channel groundwater recharge due to expansion and extension of the bypass system.

- **Reservoir operation –** The F-CO program is designed to modify operation of reservoirs in a way that will improve flood management and also provide opportunities for more aggressive refilling of reservoirs during dry years. Such operations could increase water supplies within reservoirs, especially in dry years when the water supply system is most stressed. Water supply benefits from F-BO would vary depending on current reservoir operation manual requirements, watershed hydrology, flexibility in reservoir operation (i.e., adequate release capacity), quality of reservoir inflow forecasts, etc. Therefore, a case-by-case study of flood management reservoirs will be needed to adequately define and quantify the potential benefits of reservoir F-BO.

- **Groundwater recharge –** Groundwater aquifers are naturally recharged through various processes, including percolation of precipitation and infiltration of water from lakes, canals, irrigation and in-channel groundwater recharge. Implementation of the SSIA includes expansion and extension of the bypass system and levee setbacks. These actions would expand flood system lands by an additional 35,000 to 40,000 acres, which would be flooded during high water and contribute to in-channel and floodplain groundwater recharge.

8.14.8 Reduced Long-Term Flood System Management Costs

Although not quantified for the 2012 CVFPP, the SSIA was developed to reduce the overall, long-term costs associated with flood management in the Central Valley. This includes the following:

- Reduced long-term emergency response and recovery needs
- Reduced long-term operations and maintenance costs
- Efficiency through regional approaches to permitting and regulatory needs

8.15 Land Use

SPFC improvements under the SSIA provide for higher levels of flood protection for existing land uses without taking actions that may encourage changes to those uses. Elements of the SSIA have been carefully formulated to reduce flood risk in the area protected by SPFC facilities while avoiding land use changes that promote growth in deep floodplains and increase State flood hazard liabilities. Improved flood protection with the SSIA enhances the likelihood that activities associated with each existing land use will continue to thrive.

Following is a summary of land use conditions under the SSIA:

- **Urban Land Use –** Urban and urbanizing areas within the SPFC Planning Area would achieve a minimum of 200-year (0.5% annual chance) flood protection, as specified by legislation. Legislation requires each city and county within the Sacramento-San Joaquin Valley to amend its general plan to include data, analysis, goals, and policies for protection of lives and property, and related feasible implementation measures. DWR will make data, analysis, and information gathered for the CVFPP available to local agencies for inclusion in their amended general plans. In addition, these local entities are required to amend their zoning ordinances to be consistent with their general plans. As a result, urban development would continue based on sound planning; however, the SSIA does not promote urban development in floodplains beyond existing urban/urbanizing areas.
- **Small Community Land Use –** The SSIA supports the continued viability of small communities within the SPFC Planning Area to preserve cultural and historical continuity and important social, economic, and public services to rural-agricultural populations,

agricultural enterprises, and commercial operations. Under the SSIA, several small communities within the SPFC Planning Area would achieve 100-year (1% annual chance) flood protection through structural means such as ring levees, where feasible. This would preserve small community development opportunities within specific boundaries without encouraging broader urban development. However, some small communities adjacent to existing urban areas may achieve a 100-year level of flood protection or higher as a result of improvements for the adjacent urban areas. For other small communities where structural improvements are not feasible, the SSIA proposes nonstructural means such as flood proofing and elevating structures to support continued small communities land use, providing feasible flood protection in a way that is not growth-inducing.

Limiting Growth in Central Valley Floodplains

SSIA improvements are designed to discourage growth in rural floodplains with the intention of reducing flood risks. The State does not promote flood management improvements that would induce growth in rural areas.

Urban flood risk reductions under the SSIA will be limited to areas protected by facilities of the State Plan of Flood Control.

Agricultural conservation measures proposed by the SSIA are also designed to limit conversion of agricultural land to urban uses, and to preserve the robust agricultural economy of the Central Valley.

- **Rural-Agricultural Area Land Use** – The SSIA includes improvements for rural-agricultural flood protection, but excludes participation in flood projects to achieve 100-year (1% annual chance) flood protection that would be growth-inducing and, thus, increase potential flood risks. The SSIA includes many elements to preserve rural-agricultural viability, such as purchase of conservation easements to preserve agriculture and prevent urban development, when consistent with local land use planning and in cooperation with willing landowners. Because expansion of floodways would be primarily in rural-agricultural areas, some loss of agricultural land would occur. However, based on preliminary planning, 75 percent of additional land needed for bypass expansion would continue to be farmed. The remaining 25 percent that would be subject to more frequent flooding would be converted to ecosystem uses.

The State will work with FEMA's National Flood Insurance Program to promote the continued sustainable rural-agricultural economy and to examine opportunities to provide affordable flood insurance for low risk agricultural and farming structures in the floodplain.

- **Ecosystem/Open Space Land Use** – Opportunities for ecosystem and open space land use would increase within the footprint of the flood management system facilities, especially through expansion of bypasses and select areas where setback levees for multiple benefits prove feasible. This net increase in habitat area should contribute to flood risk reduction and ecosystem restoration and enhancement, while providing for open space and recreational opportunities in rural areas.

- Setback levees along some reaches of the main rivers may increase habitat area. These setbacks are likely to be most feasible in reaches where there are known levee conditions that would be difficult to correct with fix-in-place methods, operations and maintenance problems exist, channel hydraulic performance would be significantly improved, regional flood risk reduction benefits would be realized, and/or there is an opportunity for uniquely valuable ecosystem restoration.

Feather River Setback Levee was constructed for multiple benefits including improved flow conditions

8.16 Implementing and Managing State Systemwide Investment Approach

The SSIA is a broad plan for flood system improvements and additional work is needed to refine its individual elements. Some elements have already been completed (since 2007), others will be accomplished before the first update of the CVFPP in 2017, and many will require additional time to fully develop and implement. Ongoing planning studies, engineering, feasibility studies, designs, funding, and partnering are required to better define, and incrementally fund and implement, these elements over the next 20 to 25 years.

In general, DWR will continue to prioritize its implementation efforts on the most significant flood risks. However, some critical elements could take longer to implement because of complexity, local and federal interest, and funding that will be made available incrementally over the next few decades. While implementation must occur incrementally, the accumulated outcome will be a sustainable flood management system.

Implementing and managing the SSIA includes the following:

- Flood management programs
- Levee vegetation management strategy
- Removal and addition of SPFC facilities
- Refining flood system improvements, through regional flood management plans, assisting local agencies in their land use planning, Central Valley Integrated Flood Management Study, State basin-wide feasibility studies, and program coordination, communication, and integration
- Recognition of accomplishments between 2007 and 2011, and near-term priority actions for flood management programs between 2012 and 2017
- Costs and time to implement the SSIA
- Financing strategy for SSIA implementation
- CVFPP approvals and related roles and responsibilities of partner agencies
- Implementation challenges and uncertainties related primarily to funding availability, budgetary issues, economic activities, programs, policies, and permitting

9.0 Local and Regional Project Summaries

To support development of the 2012 CVFPP, local and regional project concepts were collected from partners, stakeholders, and other interested parties through the CVFPP communication and engagement process (Phases 1 and 2). These project concepts address a wide array of local, regional, and systemwide problems and opportunities, and include various types of management actions.

Initial research has been conducted and information gathered for each proposed project concept has been summarized. Collected information was used to inform plan formulation activities. The summaries include information about the project concepts, such as project location, project proponents, project purpose, project status, extent of benefits, implementation costs, and implementation considerations.

90 proposed projects and project concepts were collected during the communication and engagement process and are listed in Table 9-1. In addition, summary forms for 56 project concepts for which information has already been gathered are also included in Attachment 7a: Local and Regional Project Summaries. These projects are indicated with an asterisk (*) on table 9-1.

Note that the information in Table 9-1 and Attachment 7a completed for the 2012 CVFPP are a work in progress. Some information is missing or incomplete, but will be updated in support of the 2017 CVFPP as project concepts are further developed and some projects are implemented in coordination with partner agencies. For more information regarding regional planning and implementation, see Section 4 of the 2012 CVFPP.

Because of the preliminary status of this project information, no attempt has been made to evaluate the feasibility of the project concepts at this level of development. Local and regional projects not included in this attachment are not precluded from participation in State programs.

Table 9-1. Local and Regional Project Concepts

Project Name	Planning Area
Complete Middle Creek project by completing land acquisition, environmental restoration, and levee decommissioning*	Lower Sacramento
Fix Cache Creek Settling basin to secure another 50 to 100 years life in the project*	Lower Sacramento
Stabilize Cache Creek through grade control structures and other measures*	Lower Sacramento
Consider additional floodplain storage within Cosumnes River preserve	Lower Sacramento
Consider Sacramento DWSC or construct peripheral canal along DWSC as bypass	Lower Sacramento
Consider Stone Lakes Refuge Bypass	Lower Sacramento
Rehabilitate and provide operable gates for Sacramento Weir*	Lower Sacramento
Rehabilitate Knights Landing Outfall structure and provide for fish exclusion	Lower Sacramento
Acquire flood easement over Conaway Ranch*	Lower Sacramento
Remove sediment and rehab structure as necessary at Fremont Weir*	Lower Sacramento
Remove Yolo Short Line RR as obstruction in Yolo Bypass flow	Lower Sacramento
Review and modify bypass channel vegetation as necessary to maintain proper balance of storage and conveyance in upper Butte Basin*	Upper Sacramento
Stabilize Cherokee Canal watershed to reduce sediment transport and long-term O&M costs*	Upper Sacramento
Modifications to the 3Bs Flood Relief Structure *	Upper Sacramento
Construct peak overflow detention basins in the Colusa Basin Drainage Area. *	Upper Sacramento
Colusa Drain improvements*	Upper Sacramento
Protect M&T pumping facilities*	Upper Sacramento
Secure meander zones along upper Sacramento River where infrastructure is threatened*	Upper Sacramento
Remove sediment and rehab structure as necessary at Moulton Weir	Upper Sacramento
Remove sediment and rehab structure as necessary at Colusa Weir*	Upper Sacramento
Raise Woodson Bridge	Upper Sacramento
Construct peak overflow detention basins on streams in Tehama County*	Upper Sacramento
Construct peak overflow detention basins on streams in Glenn County*	Upper Sacramento
Construct peak overflow detention basins on streams in Butte County	Upper Sacramento
Construct peak overflow detention basins on streams in Shasta County	Upper Sacramento
Gravel augmentation at Cottonwood Creek*	Upper Sacramento
Construction of control structures along Burch and Jewett creeks	Upper Sacramento
Stabilize Sycamore Creek erosion through construction of grade control structures*	Upper Sacramento
Rehabilitate Chico Creek Diversion Structure*	Upper Sacramento
Deer Creek Levee Setback and Environmental Enhancement Project; Lower Deer Creek Flood Reduction and Fisheries Restoration Project*	Upper Sacramento
Remove sediment and rehab structure as necessary at Tisdale Weir*	Upper Sacramento
Protect Woodson Bridge hard point*	Upper Sacramento
Acquire or expand on Egbert Tract to secure overflow capacity	Delta

Table 9-1. Local and Regional Project Concepts (contd.)

Project Name	Planning Area
Acquisition and complete restoration of Prospect Island*	Delta
Acquisition and complete restoration of Liberty Island*	Delta
Removing sunken ships in the channel/dredging	Delta
Modify marina to south of McCormack-Williamson Tract in north Delta	Delta
Bank stabilization in Delta	Delta
Clifton Court Forebay operations	Delta
Staten Island Bypass	Delta
Consider McCormack-Williamson as bypass	Delta
Silt/sand bar removal along lower San Joaquin river*	Lower San Joaquin
Modifications to previous seismic projects on the Stanislaus River near San Joaquin River confluence	Lower San Joaquin
Vegetation removal along Mokelumne River*	Lower San Joaquin
Vegetation removal and bank stabilization in the Coral Hall Road area, San Joaquin County*	Lower San Joaquin
Restore existing bypass on Mormon Channel from Calaveras River	Lower San Joaquin
Divert flow from Stockton Diverting Canal to Mormon Channel	Lower San Joaquin
New control structure on Dry Creek below Don Pedro and/or at Tuolumne confluence	Lower San Joaquin
Construct setback levees at Reclamation District 17	Lower San Joaquin
Construct wing levees (WaltHall levee)	Lower San Joaquin
Channel modifications to Tuolumne River downstream from Dry Creek	Lower San Joaquin
Protect cultural resources (i.e. Parkway – Dumna Tribal village site)	Upper San Joaquin
Consider dredging Chowchilla Bypass	Upper San Joaquin
Consider dredging Mendota Pool	Upper San Joaquin
Consider dredging San Joaquin River below Washington Road	Upper San Joaquin
Consider bank stabilization along Chowchilla Bypass	Upper San Joaquin
Consider bank stabilization near Mendota and Firebaugh	Upper San Joaquin
Reduce flow constrictions along Ash Slough and Berenda Slough*	Upper San Joaquin
Repair/modify Los Banos Creek culverts*	Upper San Joaquin
Consider Mendota Pool bypass*	Upper San Joaquin
Consider structural modifications to Mariposa bypass*	Upper San Joaquin
Consider modifying Kings River Bypass near San Mateo Road	Upper San Joaquin
Consideration of Bear Creek and Black Rascal Creek bypasses	Upper San Joaquin
Consider Westside IRWM projects*	Upper San Joaquin
Pioneer Site seepage berm*	Lower Sacramento
Levee repair of 25 erosion sites Sacramento River Bank Protection Project*	Upper and Lower Sacramento
South Sacramento County Streams Project Union House Creek channel upgrades*	Lower Sacramento

Table 9-1. Local and Regional Project Concepts (contd.)

Project Name	Planning Area
San Joaquin Area Flood Control Agency Smith Canal closure conceptualization*	Lower San Joaquin
Lower San Joaquin River Feasibility Study*	Lower San Joaquin
American River Common Features PAC and GRR*	Lower Sacramento
Frazier Creek/Strathmore Creek Feasibility Study*	Upper San Joaquin
Woodland/Lower Cache Creek General Investigation*	Lower Sacramento
Merced County Streams Feasibility Study and GRR*	Upper San Joaquin
Rock Creek/Keefer Slough Feasibility Study*	Upper Sacramento
Sutter Basin Feasibility Study *	Lower Sacramento
West Sacramento Area Flood Control Agency Project and GRR*	Lower Sacramento
West Stanislaus County/Orestimba Creek Feasibility Study *	Lower San Joaquin
White River/Deer Creek Feasibility Study *	Upper San Joaquin
Yuba River Basin Project GRR *	Lower Sacramento
Mid-Valley Area Reconstruction Project*	Lower Sacramento
Sacramento River Flood Control System Evaluation*	Upper and Lower Sacramento
Hamilton City Flood Damage Reduction and Ecosystem Restoration*	Upper Sacramento
Putah Creek Flood Reduction and Habitat Improvement Project*	Lower Sacramento
Floodplain Expansion and Ecosystem Restoration at Dos Rios Ranch*	Lower San Joaquin
Elk Slough Area Flood and Habitat Improvement Project*	Lower Sacramento
Sutter Basin Flood Corridor Conservation Project*	Lower Sacramento
Colusa Ring Levee Flood Protection and Wildlife Benefit Project*	Lower Sacramento
The Lower San Joaquin River Flood Bypass*	Lower San Joaquin
Elkhorn Basin Ecosystem Restoration Project	Lower Sacramento
Koptka Slough Restoration Project	Upper Sacramento

Note:
* = Project Summary is included in Attachment 7A: Local and Regional Project Summaries

Key:
DWSC = Deep Water Ship Channel
GRR = General Reclamation Report
IRWM = Integrated Regional Water Management
O&M = operations and maintenance
PAC = Post-Authorization Change
RR = railroad
USACE = U.S. Army Corps of Engineers

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11.0 Acronyms and Abbreviations

AB	Assembly Bill
AEP	annual exceedence probability
BDCP	Bay-Delta Conservation Plan
Board	Central Valley Flood Protection Board
CalEMA	California Emergency Management Agency
CEQA	California Environmental Quality Act
cfs	cubic foot per second
CGC	California Government Code
Comprehensive Study	Sacramento and San Joaquin River Basins Comprehensive Study
CVFED	Central Valley Flood Evaluation and Delineation Program used only twice
CVFMP	Central Valley Flood Management Planning used only once
CVFPP	Central Valley Flood Protection Plan
CVFSCS	Central Valley Flood System Conservation Strategy
CVIFMS	Central Valley Integrated Flood Management Study
Delta	Sacramento-San Joaquin Delta
Descriptive Document	State Plan of Flood Control Descriptive Document
DFG	California Department of Fish and Game
DNM	does not meet criteria
DOF	California Department of Finance
DWR	California Department of Water Resources
DWSC	Deep Water Ship Channel
EAD	expected annual damages
ETL	Engineering Technical Letter
F-BO	forecast-based operations
F-CO	Forecast-coordinated operations

FCSSR	Flood Control System Status Report
FDA	Flood Damage Assessment
FEMA	Federal Emergency Management Agency
FloodSAFE	FloodSAFE California
FPZ	Flood Protection Zone
GRR	General Reevaluation Report
HEC	Hydrologic Engineering Center
IRWM	integrated regional water management
LD	lacking sufficient data
LOP	level of protection
MG	marginal in meeting criteria
NULE	Non-Urban Levee Evaluations
NWS	National Weather Service
O&M	operations and maintenance
PAC	Post Authorization Change
PEIR	Program Environmental Impact Report
PGL	Policy Guidance Letter
PRC	Public Resources Code
Proposition 1E	Disaster Preparedness and Flood Prevention Bond Act
Proposition 84	Safe Drinking Water, Water Quality and Supply, Flood Control Protection Bond Act
RCR	Regional Conditions Report – A Working Document
Reclamation	U.S. Department of the Interior, Bureau of Reclamation
SAFCA	Sacramento Area Flood Control Agency
SB	Senate Bill
SEMS	Standardized Emergency Management System
SPFC	State Plan of Flood Control
SSIA	State Systemwide Investment Approach
State	State of California
SWP	State Water Project
TNC	The Nature Conservancy

TRLIA.................................... Three Rivers Levee Improvement Authority
ULE...................................... Urban Levee Evaluations
USACE................................. U.S. Army Corps of Engineers
USFWS................................ U.S. Fish and Wildlife Service
YCWA .... Yuba County Water Agency

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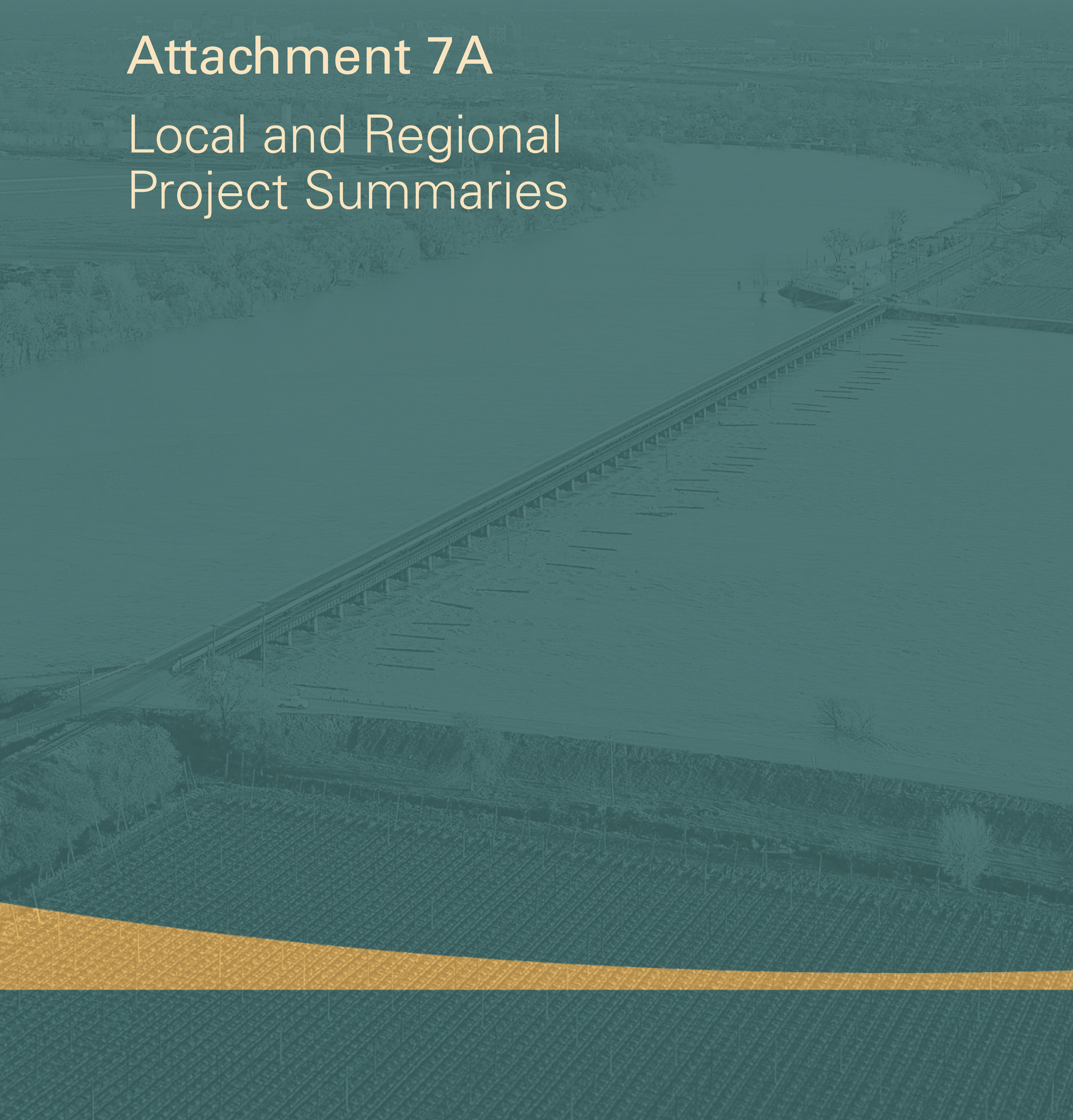
Attachment 7A

Local and Regional Project Summaries



CENTRAL VALLEY
FLOOD MANAGEMENT
PLANNING PROGRAM

FloodSAFE
CALIFORNIA

2012 Central Valley Flood Protection Plan

Attachment 7A: Local and Regional Project Summaries

June 2012

STATE OF CALIFORNIA
THE NATURAL RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

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Table of Contents

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1.0 Local and Regional Project Summaries

Draft local/regional project summary forms for 56 projects are provided on the following pages. The information was gathered to supplement what was presented in Section 9 of Attachment 7: Plan Formulation and support plan formulation activities during Phases 1 and 2 of 2012 Central Valley Flood Protection Plan (CVFPP) development. Initial research has been conducted and information gathered for each local/regional project. The summaries include information about the project type, location, project proponents, and a brief description and status as of 2011.

Note that the information in this attachment completed for the 2012 CVFPP is a work in progress. Some information is missing or incomplete, but will be updated in support of the 2017 CVFPP as project concepts are further developed and some projects are implemented in coordination with partner agencies. For more information regarding regional planning and implementation, see Section 4 of the 2012 CVFPP.

Because of the preliminary status of this project information, no attempt has been made to evaluate the feasibility of the project concepts at this level of development. Local and regional projects not included in this attachment are not precluded from participation in State programs.

1.1 Middle Creek Flood Damage Reduction and Ecosystem Restoration Project

Project Type: Floodplain Management

Location Information:

- **Region** – Lower Sacramento
- **Subregion** – Cache Creek
- **Location –** The Project is located at the north end of Clear Lake in the area bounded by State Highway 20 and Rodman Slough, see Middle Creek Location Map
- **Community Setting –** Nonurban (18 residences, 1,650 acres of agricultural land)

Project Proponents:

- **Lead Non-Federal Agency –** Lake County Flood Control and Water Conservation District
- **Lead Federal Agency** - U.S. Army Corps of Engineers (USACE)
- **Potential Partners –**Central Valley Flood Protection Board, California Department of Fish and Game (DFG)/Wildlife, Conservation Board, California State Water Resources Control Board (SWRCB), Central Valley Regional Water Quality Control Board (Central Valley Water Board), California Bay-Delta Authority, California Department of Water Resources (DWR), local Native American tribes, Resource Conservation Districts, Lake County Special Districts, Lake County watershed groups, nonprofit organizations
- **Contact Information –** Robert L. A. Lossius, Assistant Public Works Director

Description:

- **Purpose –** The project will eliminate flood risk to 18 residential structures, numerous outbuildings, and approximately 1,650 acres of agricultural land (through removal and relocation), and will restore damaged habitat and the water quality of the Clear Lake watershed.

- **Concept –** The project encompasses about 1,650 acres, extending from the current shoreline of Clear Lake to the 100-year floodplain boundary. This would restore the entire floodplain in the study area, with the exception of the tribal lands adjacent to the study area. The project plan focuses on reconnecting the floodplain of Middle Creek to the historic Robinson Lake wetland area by breaching the existing levee system to create inlets that direct flows into the study area and providing flood damage reduction by relocating residents from the floodplain.

  To accomplish this, a portion of the Middle Creek Project levee from the confluence of Scotts and Middle creeks to Clear Lake would need to be reauthorized and breached. Channels and sloughs would also be constructed to direct creek flows from the breaches through the study area to Clear Lake. A ring levee would be constructed to provide an existing level of protection for the tribal lands. Implementation of this alternative would result in 765 acres of wetlands, 230 acres of riparian, 405 acres of open water, and 250 acres of upland habitat.

  This project would also require that all structures and personal property be removed from the study area. A total of 22 structures and associated infrastructure (septic tanks, plumbing, and electrical) would be demolished and removed from the project area. Wells would be abandoned and capped as required by county and State standards. Property owners would be compensated and relocated outside the floodplain. All current agricultural practices within the floodplain would be discontinued.

- See Middle Creek Project Map.

- **Relation to SPFC Facilities –** To Be Determined

Project Status: Design (2008 – 2010); Construction (2012 – 2015)

Applicable Management Action(s): Floodplain Management – Easements/Acquisitions.

Contribution to CVFPP Goals:

- **Primary Goal –** Improve Flood Risk Management.

- **Supporting Goals –** Improve Operations and Maintenance (O&M), Promote Ecosystem Functions, Promote Multi-Benefit Projects.

Extent of Benefit Area: Regional: flooding benefits in the local area plus sediment loading reduction in Clear Lake.

Potential to Provide Multi-Benefits:

- **Flood Damage Reduction Benefit**
  - Reduce flood risk by removing structures and property at risk of severe flooding as a result of levee failure. There are 18 homes and numerous outbuildings subject to flooding should the levees fail. Approximately 1,650 acres of agricultural land would be flooded. Because flood depths are great (more than 5 feet in most locations) and would extend for extended periods, potential flood damages are high.
  - Protect more than 3 miles of public roads and a major, high-voltage Pacific Gas and Electric Company (PG&E) transmission line, which cross the project area and are currently vulnerable to flood damage, by elevating or retrofitting the existing structures.
  - The DWR currently maintains the Middle Creek Flood Control Project in the project area. The project would remove approximately 3 miles of substandard levees, one pumping station, and one weir structure from the Flood Control Project. The project would result in lower O&M ($110,000 to $160,000 per year) and emergency response costs (estimated in excess of $300,000 per major flood event) for DWR and cooperating State and federal agencies.
- **Ecosystem Restoration**
  - Restore up to 1400 acres of the 7,520 acres of historic wetlands in the Clear Lake Basin that have either been lost or severely impacted. This is a 79 percent increase in the basin’s existing wetland habitat. Of the historic 9,300 acres of freshwater wetlands that existed in the Clear Lake Basin, approximately 7,520 acres (80 percent) have been lost or severely impacted. Restored habitat includes open water, seasonal wetlands, instream aquatic habitat, shaded aquatic habitat, and perennial wetlands. Additional upland habitat will be protected adjacent to the wetland and stream areas.
  - Provide a significant increase in habitat for fish and wildlife. This project would greatly improve the bird-nesting habitat and increase the available spawning habitat for native and nonnative fish. The area is currently used extensively by migratory waterfowl.

- Preserve the fish and wildlife resources and the cultural resources in the project area.

- Several special-status wildlife species could benefit from the creation of wetland, open water, and riparian habitats in the expanded floodplain. Some species include the northwestern pond turtle (*Actinemys marmorata marmorata*), American white pelican (*Pelecanus erythrorhynchos*), double-crested cormorant (*Phalacrocorax auritus*), western least bittern (*Ixobrychus exilis*), osprey (*Pandion haliaetus*), white-tailed kite (*Elanus leucurus*), bald eagle (*Haliaeetus leucocephalus*), northern harrier (*Circus cyaneus*), Cooper's hawk (*Accipiter cooperii*), American peregrine falcon (*Falco peregrines anatum*), California yellow warbler (*Dendroica petechial*), yellow-breasted chat (*Icteria virens*), tricolored blackbird (*Egelaius tricolor*), fringed myotis (*Myotis thysanodes*), long-eared myotis (*Myotis septentrionalis*), long-legged myotis (*Myotis volans*), pallid bat (*Antroxous pallidus*), and Townsend's western big-eared bat (*Corynorhinus townsendii townsendii*).

- **Water Supply**

  - Sediment is the primary nutrient source (97 percent of Clear Lake's total phosphorus load is sediment bound) contributing to the cultural eutrophication of Clear Lake. It has been estimated that the current sediment and phosphorus load is twice the pre-European sediment load. Approximately 71 percent of the sediment and phosphorus entering Clear Lake is from Scotts and Middle Creek watersheds. It has been estimated that the project would remove up to 40 percent of phosphorus entering Clear Lake from Middle and Scotts creeks. Reduced phosphorus concentrations in Clear Lake would potentially reduce the chlorophyll concentrations by 33 percent. A corresponding reduction in total organic carbon would also be realized;

  - Wetlands are known to efficiently remove nitrogen from the water column. Because the project area is hydraulically connected to Clear Lake, it would provide some nitrogen removal benefits to Clear Lake. These benefits are unknown and have not been quantified;

  - Improved water quality in Clear Lake will reduce the cost of treating lake water to drinking water standards.

- **Recreation and Other Benefits**
  - Recreation and tourism will be enhanced by improving the water quality in Clear Lake. In 1994, the U.S. Department of Agriculture (USDA) Soil Conservation Service estimated that $7 million in tourism is lost annually due to water-quality issues in Clear Lake.

Implementation Cost: $38 million

Implementation Considerations:

- **Redirected Hydraulic Impacts –** Flood protection is provided by removing the existing structures and allowing the natural flooding to occur in the project area. This should not negatively impact flooding in surrounding areas.
- **Adverse Environmental Impact and Regulatory Issues –** Environmental Impact Statement (EIS) reports positive permanent impacts and only temporary (construction related) negative impacts (noise, fisheries, recreation, aesthetics). See Table S-1 from Feasibility Study (EIS)/Environmental Impact Report (EIR)
- **Other**

Associated Studies:

Feasibility Study/EIS/EIR, Available: <http://www.water.ca.gov/floodmgmt/fpo/sgb/fpcp/prop13/proposals/4006_MiddleCreek/Feasibility_Report.pdf >, Note: Table S-1 is available, <http://www.water.ca.gov/floodmgmt/fpo/sgb/fpcp/prop13/proposals/4006_MiddleCreek/executive_summary_table.pdf>

References:

Project Summary Sheet, Available: <http://www.water.ca.gov/floodmgmt/fpo/sgb/fpcp/prop13/proposals/4006_MiddleCreek/4006_Middle_Creek_Summary.pdf >

Project Summary Sheet 2, Available: <http://www.water.ca.gov/floodmgmt/fpo/sgb/fpcp/prop13/proposals/4006_MiddleCreek/4006summary.pdf>

Flood Protection Corridor Program (FPCP) Grant Application, Available: <http://www.water.ca.gov/floodmgmt/fpo/sgb/fpcp/prop13/proposals/4006_MiddleCreek/Application.pdf>

Middle Creek Restoration Web page, Available: <http://www.co.lake.ca.us/Government/Directory/Water_Resources/Department_Programs/Middle_Creek.htm>

1.2 Cache Creek Settling Basin Floodway Bypass

Project Type: Floodplain Management

Location Information:

- **Region** – Lower Sacramento
- **Subregion** – Cache Creek
- **Location** – Woodland, California. Near Interstate (I-) 5 and State Route 113.
- **Community Setting** – Small community

Project Proponents:

- **Potential Lead Non-Federal Agency –** Yolo County Flood Control and Water Conservation District (see Cache Creek Organizational Structure)
- **Potential Lead Federal Agency –** To Be Determined
- **Potential Partners –** City of Woodland, Yolo County, Central Valley Flood Protection Board (legal owner and operator)
- **Contact Information –** Fran Borcalli (floodSAFE Yolo)

Description:

- **Purpose** – Relieve flooding associated with poor hydraulics through the Cache Creek Settling Basin (severe flood events only).
- **Concept** – The Cache Creek Settling Basin is currently used to trap mercury-laden sediments before Cache Creek enters the Yolo Bypass, reducing sediment loading inside the bypass. In 1992, modifications were made to the settling basin (new levees, increased height on existing levees) with the intent of trapping additional sediment; however, the unintended result was increased flooding in the area. The proposed modification would move the levees north and west to create a floodway that would be used to bypass the settling basin during severe flood events (see Cache Creek Map).
- **Relation to SPFC Facilities** – To Be Determined

Project Status: FloodSAFE Yolo presentation (June 22, 2009) targeted October 2009 for conducting the Feasibility Study, but no documentation was found. floodSAFE Yolo's Web site only has information through mid-2009.

Applicable Management Action(s): System Modifications – Bypasses.

Contribution to CVFPP Goals: Indicates the draft 2012 CVFPP goal to which the project is likely to contribute to. Because each project has the potential to contribute to more than one goal, all applicable goals are identified.

- **Primary Goal –** Improve Flood Risk Management.
- **Supporting Goals –** Promote Multi-Benefit Projects.

Extent of Benefit Area: Local benefits through flood mitigation. Potential regional costs due to increased sediment transport into Yolo Bypass and downstream.

Potential to Provide Multi-Benefits:

- **Flood Damage Reduction Benefit –** Bypass floodway would reduce flooding in Woodland.
- **Ecosystem Restoration –** Possible restoration applications.
- **Water Supply –** Not applicable.
- **Recreation and Other Benefits –** Not applicable.

Implementation Cost: Not available

Implementation Considerations:

- **Redirected Hydraulic Impacts –** The area downstream from this project is the Yolo Bypass, which is designed to handle large flood volumes. Reducing flooding in the Cache Creek Settling Basin probably will not result in overtopping of the bypass, unless significant sediment loading reduces the capacity (see below).
- **Adverse Environmental Impact and Regulatory Issues –** The issues identified below address the complete removal of the settling basin, not just the addition of the floodway bypass:

- Sediment disposition in the Yolo Bypass would inundate and render useless 435 acres of abandoned industrial waste oxidation ponds owned by the City of Woodland.
- Backwater effects caused by the sediment deposited in the Yolo Bypass would require the following modifications to the Sacramento River Flood Control Project:
- Yolo Bypass levees would need to be raised a maximum of 2.2 feet from .8 miles downstream from I-5, upstream to the Fremont Weir.
- Knights Landing Ridge cut levees would need to be raised 1.8 feet.
- Sacramento River levees would need to be raised a maximum of 1 foot from the Fremont Weir to the Sacramento Bypass.
- Dredging in the Sacramento River System and San Francisco Bay System would be decreased annually by 88 and 7 acre-feet, respectively.

- Other

Associated Studies:

To Be Determined

References:

floodSAFE Yolo Cache Creek Settling Basin webpage, Available: <http://www.ycfcwcd.org/settlingbasin.html>

floodSAFE Yolo Presentation: Cache Creek Settling Basin Symposium: Managing the Basin – Who's Doing What? June 22, 2009. Francis E. Borcalli, PE. Available: <http://www.ycfcwcd.org/documents/CacheCreekSettlingBasinPresentation.pdf>

floodSAFE Yolo Fact Sheet: Floodplain Interrupted: The Story of Cache Creek Settling Basin. Available: <http://www.ycfcwcd.org/documents/FloodplainInterruptedFactSheet.pdf>

Flood control: Fix the Settling Basin, Opinion Piece by Dr. Bill Marble Chair of the Water Resources Association and Woodland City Councilmember. Available:

<http://www.woodlandrecordtv.com/files/WoodlandRecordJune09Web.pdf>

1.3 Stabilize Cache Creek Through Grade Control Structures and Other Measures

Project Type: System Modifications

Location Information:

- **Region** – Lower Sacramento
- **Subregion** – Cache Creek
- **Location –** Cache Creek in Yolo County
- **Community Setting –** Multiple projects through the creek basin mostly in nonurban areas, or small communities with a flood control goal of protecting an urban area (City of Woodland)

Project Proponents:

- **Potential Lead Non-Federal Agency** – Yolo County Flood Control Water Conservation District, Yolo County, City of Woodland
- **Potential Lead Federal Agency** – USACE
- **Potential Partners –** Cache Creek Conservancy, Cache Creek Conservancy**,** Yolo County Resource Conservation District, Lake County Flood Control & Water Conservation District, Cache Creek Water Forum, Cache Creek Wild, Cache Creek Aggregate Producers, DFG, DWR, Federal Emergency Management Agency (FEMA), Reclamation District 2035, Riparian Landowners, State Reclamation Board, Town of Esparto, Town of Madison, Tuleyome, U.S. Bureau of Land Management, U.S. Fish and Wildlife Service (USFWS)
- **Contact Information** – Fran Borcalli (floodSAFE Yolo)

Description:

- **Purpose** – Periodic high flows in Cache Creek cause extensive bank erosion, levee degradation, and local flooding, threatening the north and northeast sections of the City of Woodland and the town of Yolo.
- **Concept** – A well-planned series of projects and programs will ultimately provide 200-year level or greater of flood protection and levee integrity by combining the cumulative effects of integrated actions throughout the Cache Creek corridor. These projects are

collectively referred to as the Cache Creek Integrated Project, which combines integrated flood management and integrated water management programs for Cache Creek. They are discussed in the Yolo County Integrated Regional Water Management Plan (IRWMP).

- **Relation to SPFC Facilities –** Multiple levees and dams throughout the Cache Creek corridor.

Project Status: Most of the projects are still in the planning stage. A few are complete (e.g., Creation of the FloodSAFE Yolo pilot program), while others are in the construction stage (e.g., Capay Dam reliability/restoration project), and others are ongoing (e.g., Corell-Rodgers Wetlands Enhancement Project).

Applicable Management Action(s): System Modifications – Levees/Floodwalls/Hydraulic Structures

Note: Different projects would address different management actions, and to one degree or another span all the primary management actions. The Yolo County IRWMP organized the Cache Creek Integrated Project within a framework of three elements. These are:

- Flood Management Element (11 projects/actions).
- Water and Aquatic Habitat Element (14 projects/actions).
- Recreation and Riparian Habitat Element (10 projects/actions).

Contribution to CVFPP Goals:

- **Primary Goal –** Improve Flood Risk Management.
- **Supporting Goals –** Improve O&M, Promote Ecosystem Functions, Improve Institutional Support, Promote Multi-Benefit Projects.

Extent of Benefit Area: The project addresses the entire Cache Creek corridor and would therefore have local, regional, and systemwide benefits.

Potential to Provide Multi-Benefits: Different projects within the Cache Creek Integrated Project may contribute to different benefit categories.

- **Flood Damage Reduction Benefit –** E.g., Cache Creek North Levee Setback project.
- **Ecosystem Restoration –** E.g., Corell-Rodgers Wetlands project.

- **Water Supply –** E.g., Capay Dam reliability/restoration project.
- **Recreation and Other Benefits –** E.g., Cache Creek Nature Preserve Improvement project.

Implementation Cost: Costs vary by project. E.g., Corell-Rodgers Wetlands Project ($70,000); Cache Creek north Levee Setback project ($5.7 million)

Implementation Considerations:

- **Redirected Hydraulic Impacts –** The goal of the Cache Creek Integrated Project is to address the creek channel as a whole and determine how each project affects upstream and downstream impacts.
- **Adverse Environmental Impact and Regulatory Issues –** Flood management actions, especially structural management actions, have the potential to adversely impact the environment while meeting other flood management goals. The potential impacts of this project are yet to be determined.
- **Other**

Associated Studies

Cache Creek North Levee Setback Project IS/Proposed Mitigated Negative Declaration and Environmental Assessment. Available: <http://wrca.library.ucr.edu/digitaldocs/296.pdf>

Draft YCFCWCD-YZWD Conjunctive Use Feasibility Study. Available: <http://www.ycfcwcd.org/documents/ycfc-yzwd-report_1-22-07.pdf>

Capay Dam Apron Replacement Project IS/Proposed Mitigated Negative Declaration and Environmental Assessment. Available: <http://www.ycfcwcd.org/documents/208607-capay-ismnd.pdf>

Cache Creek Fisheries Survey. Available: <http://www.yolowra.org/Library/Final%20Cache%20Creek%20Fish%20Survey%20Report%202008%20(revised).pdf>

Cache Creek Settling Basin. Available: <http://www.ycfcwcd.org/settlingbasin.html>

References

Yolo County IRWMP. Available: <http://yolowra.org/irwmp_documents.html>

Water Resources Association of Yolo County. Available: <http://www.yolowra.org/index.html>

1.4 Rehabilitate and Provide Operable Gates for Sacramento Weir

Project Type: System Modifications

Location Information:

- **Region** – Lower Sacramento
- **Subregion** – Sacramento
- **Location –** Sacramento Weir
- **Community Setting** – Urban

Project Proponents:

- **Potential Lead Non-Federal Agency –** DWR
- **Potential Lead Federal Agency –** USACE
- **Potential Partners** – To Be Determined
- **Contact Information –** To Be Determined

Description:

- **Purpose –** Rehabilitate and provide operable gates for Sacramento Weir to improve operational flexibility, safety, and O&M costs. Sacramento is the only weir that requires manual operation for flow release and requires more active operations. It is a gated low dam along the west bank of the Sacramento River where 48 wooden weir gates are manually opened when flood stage in the Sacramento River at the "I" Street Bridge reach 27.5 feet above mean sea level (msl) (i.e., 98,000 cubic feet per second (cfs)). Sacramento Weir diverts Sacramento River water into the Yolo Bypass when it backs up from American River flows.

- **Concept –** Increase the frequency and duration of Yolo Bypass inundation via the modification of the Fremont or Sacramento weirs to improve fish migration, food production, and spawning and rearing habitat. Modifications will be made to reduce leakage at the Sacramento Weir and therefore reduce attraction of fish from the Yolo Bypass to the weir where they are blocked and could become stranded. This action may require excavation of a channel to convey water from the Sacramento River to the Sacramento Weir and from the Sacramento Weir to the Toe Drain, construction of new gates at a portion of the weir, and minor modifications to the stilling basin of the weir to ensure proper basin drainage. Specific design criteria of the ramps would need to be determined (BDCP, 2010).

Rehabilitate and provide operable gates for Sacramento Weir to improve operational flexibility, safety, and O&M costs.

- **Relation to SPFC Facilities –** Sacramento Weir

Project Status: Conceptual

Applicable Management Action(s): System Modifications – Levees/Floodwalls/Hydraulic Structures

Contribution to CVFPP Goals:

- **Primary Goal –** Improve flood risk management
- **Supporting Goals –** Improve O&M

Extent of Benefit Area: Project has local and regional benefits.

Potential to Provide Multi-Benefits:

- **Flood Damage Reduction Benefit –** Reduce potential flood damage if the Sacramento Weir were compromised or should fail, affecting the Sacramento Metropolitan Area, which includes residential homes, large infrastructure, transportation, business, and agricultural farmland.
- **Ecosystem Restoration –** Sacramento Weir improvements would reduce juvenile fish stranding and improve upstream adult fish passage.
- **Water Supply –** None
- **Recreation and Other Benefits –** None

Implementation Cost: Unknown at this time

Implementation Considerations:

- **Redirected Hydraulic Impacts –** Hydraulic impacts are not known at this time, and analysis would have to refer to the EIR if project approved.
- **Adverse Environmental Impact and Regulatory Issues –** No adverse environmental impact anticipated, analysis would have to refer to the EIR if project approved.

- **Other**

Associated Studies

None

References

Bay Delta Conservation Plan (BDCP). Local Issues Group Meeting – Yolo Bypass Fishery Enhancement Meeting Handouts. October 6, 2010. Available: <http://baydeltaconservationplan.com/Libraries/General_Documents/10-06-10_BDCP_Info_Packet-Yolo.sflb.ashx>. Accessed: May 11, 2011.

Central Valley Flood Management Planning Program. Draft State Plan of Flood Control Descriptive Document. January 2010.

1.5 Conaway Ranch Flood Easement

Project Type: Floodplain Management

Location Information:

- **Region –**Lower Sacramento
- **Subregion** – Yolo
- **Location** – East of Davis and Woodland
- **Community Setting** – Nonurban area

Project Proponents:

- **Potential Lead Non-Federal Agency** – Yolo County
- **Potential Lead Federal Agency –** To Be Determined
- **Potential Partners** – To Be Determined
- **Contact Information** – To Be Determined

Description:

- **Purpose –** Restrict the existing development rights to maintain the agricultural and open space character of the Conaway Ranch, with the associated fish and wildlife habitat values, while allowing the implementation of a multi-objective resources management program.

- **Concept** – The Conaway Preservation Group (CPG) was asked to convey a conservation easement that will be sufficiently restrictive of development and use rights to support grant funding from one or more of the funding sources administered by the Wildlife Conservation Board, while at the same time being sufficiently flexible to accommodate the further resource management projects envisioned for the Conaway Ranch.

  This project was abandoned after a settlement was reached in 2006 that requires CPG to notify Yolo County regarding any water transfers; provide first right to negotiate to Yolo County for any short- or long-term water rights transfers, or sale of the ranch; seek Yolo County's input for public access projects; and to pay for fees and cost of suit.

- **Relation to SPFC Facilities –** SPFC Lands

Project Status: Abandoned

Applicable Management Action(s): Floodplain Management – Easements/Acquisitions

Contribution to CVFPP Goals:

- **Primary Goal –** Improve Flood Risk Management
- **Supporting Goals –** Promote Ecosystem Functions, Promote Multi-Benefit Projects

Extent of Benefit Area: Project would have local benefits.

Potential to Provide Multi-Benefits:

- **Flood Damage Reduction Benefit** – Significantly increase flood protection for the Sacramento region, including Natomas and downtown Sacramento, by opening the proposed conservation easement area to accommodate periodic, temporary flood flows.
- **Ecosystem Restoration –** Enhance fish passage through the Yolo Bypass and increase access to seasonally inundated floodplain habitat on Conaway Ranch to contribute to efforts to improve conditions for native fish and provide the foundation for other enhancement projects.
- **Water Supply**
- **Recreation and Other Benefits** – Provide managed public recreation and environmental education opportunities.

Implementation Cost: To Be Determined

Implementation Considerations:

- **Redirected Hydraulic Impacts –** To Be Determined
- **Adverse Environmental Impact and Regulatory Issues –** Flood management actions, especially structural management actions, have the potential to adversely impact the environment while meeting other flood management goals. The impacts of this project have not yet been determined
- **Other**

Associated Studies

To Be Determined

References

Conaway Settlement Agreement. Available: <http://www.conawayranch.com/files/u1/ConawaySettlementAgreement.pdf>

Conaway Ranch - Protected! By Family Water Alliance. Available: <http://www.familywateralliance.com/issues_conaway.html>

Conservation Easement Strategy. Available: <http://www.conawayranch.com/files/u1/Conservation_Easement_-_Strategy.pdf>

1.6 Remove Sediment and Rehabilitate Structure, as Necessary, at Fremont Weir

Project Type: Operations and Maintenance

Location Information:

- **Region –** Lower Sacramento
- **Subregion** – Yolo
- **Location –** Fremont Weir
- **Community Setting** – Nonurban

Project Proponents:

- **Potential Lead Non-Federal Agency** – DWR
- **Potential Lead Federal Agency –** USACE
- **Potential Partners** – To Be Determined
- **Contact Information –** To Be Determined

Description:

- **Purpose** –The area between the Fremont Weir and the Sacramento River is one of high sediment deposition, as fast-moving water from upstream meets slower moving water in the Yolo Bypass. Sediment buildup and vegetative growth diverts water into the Yolo Bypass. When silt and vegetation build up in a bypass, the flood control channel becomes shallower and hydraulically less efficient and has less water-carrying capacity. As a result, more water flows down the main part of the river, putting more pressure on the levees downstream, and increases the chance of a levee break.

- **Concept –** DWR plans to dredge around the Fremont Weir to restore flow capacity. The Fremont Weir sediment removal project involves discharging up to 1,000,000 cubic yards of sediment removed from the weir to adjacent agricultural land. The discharger has demonstrated that the sediments are not contaminated with pesticides and have similar leachable metal contents as native soils at the discharge site. Therefore, the discharge of dredged sediment poses little or no threat to water quality and a conditional waiver of Waste Discharge Requirements (WDR) is appropriate for this portion of the project.

The January 12, 2009, draft of the Bay-Delta Conservation Plan (BDCP) proposes to add a notch to the Fremont Weir and flood the Yolo Bypass more frequently and for longer periods later in the agricultural season. There is a proposed measure to "modify the Fremont Weir and the Yolo Bypass to create an operable gate to sustain flood flows into the Bypass for 30 to 45 days between December 1 and May 15 to create floodplain habitat for Chinook salmon (*Oncorhynchus tshawytscha*) and Sacramento splittail (*Pogonichthys macrolepidotus*). This would eliminate the current agricultural activities, curb all public use when the Fremont Weir is spilling, and prevent the wetland management practices.

- **Relation to SPFC Facilities –** Fremont Weir

Project Status: Completed (Nov. 15, 2006) or may be under construction

Applicable Management Action(s): O&M – Dredging and Clearing

Contribution to CVFPP Goals:

- **Primary Goal –** Improve Flood Risk Management
- **Supporting Goals –** Improve O&M, Improve Institutional Support, Promote Multi-Benefit Projects

Extent of Benefit Area: The project has local, regional, and systemwide benefits.

Potential to Provide Multi-Benefits:

- **Flood Damage Reduction Benefit –** Removing sediment and improving the Fremont Weir would alleviate the threat to public safety and the potential liability for substantial damages from backwater effects of restricted flood flows. This weir is close to the Sacramento Metropolitan Area, which would be in potential danger if sedimentation problems to the Fremont Weir were not addressed.
- **Ecosystem Restoration –** None
- **Water Supply –** None
- **Recreation and Other Benefits –** None

Implementation Cost: $2.6 million budget to remove built-up sediment and vegetative growth from Fremont Weir. Unknown cost of weir modification.

Implementation Considerations:

- **Redirected Hydraulic Impacts –** Hydraulic changes are expected to have beneficial impacts.
- **Adverse Environmental Impact and Regulatory Issues –** No adverse affects.
- **Other**

Associated Studies

To Be Determined.

References

Rominger, Robyn. Farmers urging funding for flood-control channels. California Farm Bureau Federation. February 4, 2001.

Water Resources Association of Yolo County. Integrated Regional Water Management Plan. Putah Creek Meeting. 2007. Available: <http://www.yolowra.org/Final_IRWMP_April07/16-Appendix%20E-1_E-2_Stakeholder_SacRiverMtgs.pdf>. Accessed: May 11, 2011.

California Department of Fish and Game. Yolo Bypass Wildlife Area Land Management Plan. June 2008.

Project Summary. Available: <http://www.swrcb.ca.gov/rwqcb5/board_decisions/tentative_orders/0605/fremont/fremont-buff.pdf>. Accessed: May 10, 2011

Water Education Foundation. Flood Management Tour shows participants real world solutions to California's flood issues. Aquafornia, the California Water News Blog. Posted: June 22, 2009. Available: <http://aquafornia.com/archives/9611>

1.7 Review and Modify Bypass Channel Vegetation as Necessary to Assure Proper Balance of Storage and Conveyance in Upper Butte Basin

Project Type: Operations and Maintenance

Location Information:

- **Region –** Upper Sacramento
- **Subregion –** Butte Basin
- **Location –** The Butte Basin is a natural overflow area that extends from south of Big Chico Creek to the Sutter Buttes. Located along the western boundary of Butte County and the eastern boundary of Glenn County, it is bisected by State Highway 162 and located approximately halfway between State Highways 99 and 45 in the Pennington, West of Biggs, Butte City, Llano Seco, and Nelson U.S. Geological Survey (USGS) 75 minute quadrangles
- **Community Setting –** Other

Project Proponents:

- **Potential Lead Non-Federal Agency –** DWR
- **Potential Lead Federal Agency –** USACE
- **Potential Partners –** Butte Creek Watershed Conservancy, DFG, Wildlife Conservation Board, USFWS
- **Contact Information –** To Be Determined

Description:

- **Purpose –** Flooding is an increasing problem in the middle and lower parts of the Butte Basin watershed, most likely due to the lack of storage in the upper Butte Basin and urbanization through the covering of land with impermeable surfaces. Flooding has become an issue primarily in human-inhabited reaches such as the residential areas along the middle section of Butte Creek. Certain areas within this reach also appear to have the highest amount of meandering, due to the nature of the bed material, the human-introduced mining tailings, and lack of intact and mature riparian vegetation.

The 1997 Emergency Watershed Protection projects helped stabilize banks using large rock riprap and concrete, which is not conducive to productive riparian habitat. Further, they accelerate flows, increased bed scour in some areas, deposition in others, downstream bank erosion, and ultimately may cause future problems for property owners downstream.

- **Concept –** Some implementation methods may include the following:

  Restore Riparian, Wetland, and Upland Habitat – This reach contains numerous opportunities for ecosystem restoration through the establishment of healthy habitat. This measure can accomplish restoration goals through levee modifications, and realignments of existing levees and other structural changes. This measure could also be combined with other measures that call for the establishment of transient storage areas. Restoration of vegetation within the conveyance system can reduce flow capacity, but can also improve reliability of the system by stabilizing banks and reducing erosion. This measure was retained for further consideration.

  Channelization – Channelization could be performed in this reach of the Sutter Bypass by creating a larger low-flow channel to provide more rapid drainage for the Butte Basin. The channel would drain to the southern end of Butte Basin. It would also provide for ecosystem habitat.

- **Relation to SPFC Facilities –** Colusa Weir, Moulton Weir, 3Bs Weir, Goose Lake Weir, and M&T Weir

Project Status: Conceptual

Applicable Management Action(s): O&M – Vegetation Management

Contribution to CVFPP Goals:

- **Primary Goal –** Improve Flood Risk Management
- **Supporting Goals –** Improve O&M, Promote Ecosystem Functions, Promote Multi-Benefit Projects

Extent of Benefit Area: This project has local and regional benefits.

Potential to Provide Multi-Benefits:

- **Flood Damage Reduction Benefit –** The upper Butte Basin and downstream communities would benefit with greater flood storage at the upstream. This project will have an effect in the peak stage, reducing peak flows and on "high" flow duration.

- **Ecosystem Restoration –** Project can provide opportunities for management, including maintenance, enhancement, protection, and restoration of communities for a variety of resident and migratory birds, mammalian species, special status species and their habitats, riverine species, and riparian communities. O&M staff can monitor leading populations and control of exotic weeds and other invasives; maintaining or enhancing in-stream flows, implementing best management practices for mosquito control in managed wetlands,

- **Water Supply –** There are possible conjunctive use opportunities using Butte Basin as a site in exchanging conservation space with groundwater. The existing surface water distribution system would need to be expanded.

- **Recreation and Other Benefits –** Potential to integrate climate change strategies in the goals, O&M tasks on the site, including fuel reduction for habitat diversity or for adjacent residential and urban interface mandates. Project can mirror other programs that reduce greenhouse gas emissions in facilities, residences, and vehicles that are maintained and operated on the properties.

Implementation Cost: Based on Upper Butte Basin Wildlife Area Land Management Plan (O&M costs): $1.08 million for Staffing Costs and $865,000 for Operational Costs. These costs are for the entire plan, not sure just this particle efforts.

Implementation Considerations:

- **Redirected Hydraulic Impacts –** Improvements to the upper Butte Basin will only improve the hydraulics downstream from the system. Hydraulic impacts are unknown at this time.

- **Adverse Environmental Impact and Regulatory Issues –** Project may affect the ecosystem habitat during implementation but beneficial environmental impacts are greater in the long term.

- **Other**

Associated Studies

To Be Determined

References

Butte Creek Watershed Conservancy. Butte Creek Watershed Project – Existing Conditions Report. August 1998. Available: <http://buttecreekwatershed.org/Watershed/ECR.pdf>. Accessed: April 28, 2011

Upper Butte Basin Wildlife Area Draft Land Management Plan. October 2009. Available: <http://www.dfg.ca.gov/lands/mgmtplans/ubbwa/>. Accessed: April 29, 2011

1.8 Stabilize Cherokee Canal Watershed to Reduce Sediment Transport and Long-Term O&M Costs

Project Type: Excessive sedimentation and debris accumulation in the Cherokee Canal clogs the channel and results in channel bank overtopping in high-flow events. This project aims to stabilize Cherokee Canal by reducing sediment transport and long-term O&M costs.

Location Information:

- **Region –** Upper Sacramento
- **Subregion** – Butte Basin
- **Location –** Cherokee Canal, which was originally constructed to protect agricultural land from mining debris, now serves as an irrigation drainage canal. Dry Creek becomes Cherokee Canal northeast from Richvale, and Gold Run and Cottonwood Creek join the Cherokee Canal upstream of the Richvale Road crossing. Cherokee Canal eventually enters Butte Creek near the southwestern corner of Butte County, south of Highway 162

  Cherokee Canal, a tributary of the Butte Creek/Butte Basin element of the Sacramento River Flood Control Project, is a 21-mile-long leveed channel from Dry Creek to the Butte Sink in Butte County, California
- **Community Setting** –Nonurban

Project Proponents:

- **Potential Lead Non-Federal Agency** – DWR
- **Potential Lead Federal Agency** – USACE
- **Potential Partners –** Butte County, California Department of Fish and Game (CDFG) and the local watershed groups (Butte Creek Watershed Conservancy, Cherokee Watershed Group, Cherokee Watershed Alliance, Butte County Resource Conservation District, etc.). Enlisting the assistance of the California Conservation Corps could significantly reduce the cost of maintenance
- **Contact Information** – Craig Gaines (USACE)

Description:

- **Purpose –** The primary flooding hazards within the Cherokee Watershed is caused by sedimentation and structures located within the FEMA Special Flood Hazard Area (SFHA). According to a 1970 report by DWR (*Debris Deposition in the Cherokee Canal Flood Control Project*), Cherokee Canal experiences flooding due to heavy rains and valley flooding. After several historical attempts to rectify the sediment and debris loading of the channel and in response to the Sacramento River Major and Minor Tributaries Flood Control Act of 1944, the USACE developed the *Review of Interim Flood Control Survey Report of Sacramento River and Tributaries, Cherokee Canal and Butte Creek, 15 June 1948*. The report recommended building a levee and channel flood control project and the present Cherokee Canal was constructed in 1960 based upon the recommendations in the report. Dry Creek contributes the most sediment to Cherokee Canal. According to a recent study of the hydrologic, hydraulic, and sediment yield/transport in Dry Creek and Cherokee Canal (USACE, 2003), it is estimated that 103,000 tons of sediment would be delivered to Cherokee Canal in a 100-year event.

- **Concept –** Establish a regular channel maintenance and sedimentation removal program.

- **Relation to SPFC Facilities –** Not applicable

Project Status: Reconnaissance Level

Applicable Management Action(s): O&M: Vegetation Management

Contribution to CVFPP Goals:

- **Primary Goal –** Improve Flood Risk Management

- **Supporting Goals –** Improve O&M, Promote Ecosystem Functions, Improve Institutional Support, Promote Multi-Benefit Projects

Extent of Benefit Area: This project would have local, regional, and/or systemwide benefits.

Potential to Provide Multi-Benefits:

- **Flood Damage Reduction Benefit –** This project would reduce the flood risk on critical facilities in the Cherokee Watershed, which includes police department, hospitals, Red Cross shelters, schools, facilities holding hazardous materials and air transportation facilities.

Clearance of sedimentation and debris would maintain water capacity of the Cherokee Canal and prevent flow restrictions caused by buildup.

- **Ecosystem Restoration –** Maintenance of sedimentation and debris in the Cherokee Canal would prevent disturbance of fish and other natural habitat. This project would promote ecosystem restoration with the clearing of sediment and debris buildup along the canal and against overpasses, bridges, etc.

- The project would include a 300- to 400-acre wetlands restoration site about 10 miles northwest of Oroville and preserve about 840 acres of existing wetland/riparian habitat along the canal downstream from the restoration site by controlling sediment transport. This would establish a rich diversity of habitats for migratory waterfowl, resident birds, and other wildlife, including several listed endangered species.

- **Water Supply –** Not applicable

- **Recreation and Other Benefits –** Not applicable

Implementation Cost: Cost of this project would be dependent on the process of the development of the sediment removal program. Project funding for maintenance could be shared between the State and local agencies. A detailed cost estimate would be developed at the time of project implementation.

Implementation Considerations:

- **Redirected Hydraulic Impacts –** This would improve and maintain the hydraulics of the Cherokee Canal. When sedimentation and debris collect along the streams and builds up on the sides of the bridges, it results in a reduction in flow capacity and creates a blockage of flow upstream from the obstruction(s), ultimately changing the hydraulics of this system. Continued maintenance of this channel would improve hydraulics and reduce the flood risk for this area.

- **Adverse Environmental Impact and Regulatory Issues –** There are no potential adverse environmental impacts or regulatory issues.

- **Other**

Associated Studies

To Be Determined

References

Butte County. Butte County Flood Mitigation Plan. 2006. Available: <http://www.buttecounty.net/~/media/County%20Files/OEM/Public%20Internet/Butte%20FMP%20-%20FINAL%201-8-10.ashx>. Accessed April 19, 2011.

1.9 Modifications to the 3Bs Natural Overflow Area

Project Type: System Modifications

Location Information:

- **Region –** Upper Sacramento
- **Subregion** – Butte Basin
- **Location –** North of Ord Ferry Road on the Sacramento River river mile (RM) 186.5 +/-
- **Community Setting –** Nonurban

Project Proponents:

- **Potential Lead Non-Federal Agency –** Mike Inamine, Sutter Butte Flood Control Agency
- **Potential Lead Federal Agency –** To Be Determined
- **Potential Partners –** To Be Determined
- **Contact Information** – To Be Determined

Description:

- **Purpose –** 3Bs Natural Overflow Area is not operated or designed correctly. The result is that head cuts allow overflows into Butte Basin when the Sacramento River is well below flood stage, resulting in extensive, unnecessary damages to infrastructure and agriculture and reducing the storage capacity of Butte Basin for a major storm event. This project would include modifications of the existing 3Bs Natural Overflow Area for proper design and operation.

  The 3Bs is one of the three low points on the east side of the Sacramento River where floodwater flows away from the main river channel during high flows. The 3Bs Natural Overflow Area, critical to the operation of Butte Basin, was never designed or constructed to operate as a Flood Relief Structure (FRS).

  The State Plan Flood Control (SPFC) relies on the 3Bs Natural Overflow Area to protect downstream levees on the Sacramento River.

Overflow in the Butte Basin still occurs and is essential to the success of the downstream flood management system along the Sacramento River. Of the three prominent overflow areas include 3Bs (as well as M&T and Goose Lake) is about 15.5 river miles downstream from Chico Landing. As SPFC facilities for which the State has maintenance responsibility under the California Water Code (CWC), DWR maintains both the State-constructed overbank flow features (M&T and Goose Lake FRS) and the USACE-constructed bank stabilization features of the 1986 Butte Basin Plan. The Central Valley Flood Protection Board (Board) requires the elevation of 3Bs Natural Overflow to remain at or below the elevation required for flood flows to overtop when the gage at Ord Ferry Bridge reaches 114 feet National geodetic Vertical Datum (NGVD), which is equivalent to a flood flow of approximately 100,000 cfs.

- **Concept** – To Be Determined.
- **Relation to SPFC Facilities** – 3Bs Natural Overflow area. Other facilities in the Butte Basin Overflow area include Good Lake FRS and M&T.

Project Status: Conceptual Level

Applicable Management Action(s): System Modifications: Levees/Floodwalls/Hydraulic Structures

Contribution to CVFPP Goals:

- **Primary Goal** – Improve Flood Risk Management
- **Supporting Goals** – Improve O&M

Extent of Benefit Area: This project would have local, regional, and systemwide benefits.

Potential to Provide Multi-Benefits:

- **Flood Damage Reduction Benefit** – Elimination of unnecessary damage to property, agriculture, and infrastructure damages. Elimination of needless interruptions of interstate commerce (roads will not be flooded except in a flood event).
- **Ecosystem Restoration** – Not applicable
- **Water Supply** – Preserves flood storage for major flood event (systemwide benefit)

- **Recreation and Other Benefits –** Improved public safety (only floods during a flood event)

Implementation Cost: To Be Determined

Implementation Considerations:

- **Redirected Hydraulic Impacts –** Improving the 3Bs Natural Overflow Area may increase the flood storage capacity in the Butte Basin. As this project is only a modification of the existing 3Bs Natural Overflow, none or minimal adverse hydraulic impacts are expected upstream and downstream from the system. Flood risk downstream and upstream from the project location should either improve.

- **Adverse Environmental Impact and Regulatory Issues –** Modification to the 3Bs Natural Overflow Area may have adverse effects on the hydraulics of the system and local environmental effects. An environmental impact assessment would have to be considered for this project.

- **Other**

Associated Studies

To Be Determined

References

Sacramento River Conservation Area Forum Handbook. 2003. Available: <http://www.sacramentoriver.org/srcaf/publications/handbook/Ch5_SacRivHand03_webready.pdf>. Accessed April 18, 2011.

Adams, Ronald and David Gallo. The Economic Impact on Glenn County of Public Land Acquisition and Habitat Restoration Activities in the Sacramento River Conservation Area. 2001. Available < http://www.sacramentoriver.org/SRCAF/library_doc/Glenn_County_Economic_Impact_Study_Restoration_(2001).pdf>. Accessed April 18, 2011

California Department of Water Resources (DWR). State Plan of Flood Control Facilities. 2010. Available: < http://www.water.ca.gov/cvfmp/docs/SPFCDescriptiveDocNov2010Section3Part4.pdf>. Accessed April 19, 2011

1.10 Construct Peak Overflow Detention Basin in the Colusa Basin Drainage Area

Project Type: Additional Storage

Location Information:

- **Region –** Upper Sacramento
- **Subregion –** Colusa Basin Drain
- **Location –** Wilson Creek and Willow Creek
- **Community Setting –** Other

Project Proponents:

- **Potential Lead Non-Federal Agency –** Colusa Basin Drainage District
- **Potential Lead Federal Agency –** To Be Determined
- **Potential Partners –** DWR, Glenn County, local interest groups
- **Contact Information –** Ernie Ohlin, Deputy Director of Public Works – Water Resources, Tehama County

Description:

- **Purpose –** Alleviating peak flood flows, reduce the flood risk
- **Concept –** Create detention facilities to alleviate peak flows. Project would capture surface stormwater for conservation, conjunctive use, and increased water supply. The Colusa Basin Drainage District (CBDD) is currently planning two flood water detention facilities: one west of Willows on South Fork Willow Creek to reduce flooding in Willows, and one in the Wilson Creek area. The South Fork Willow Creek Detention Facility is completely designed, has nearly all permits secured, and has a bid packet ready for distribution as soon as funding becomes available. The Wilson Creek Detention Facility still requires further study to determine its feasibility. In addition to these two sites, the CBDD has other sites in Glenn and Colusa counties targeted for remediation measures, including, but not limited to, detention facilities (2008).

- **Relation to SPFC Facilities –** None

Project Status: Design (South Fork Willow Creek Detention Facility), Feasibility (Wilson Creek Detention Facility)

Applicable Management Action(s): Additional Storage – Floodplain (Transitory) Storage

Contribution to CVFPP Goals:

- **Primary Goal –** Improve Flood Risk Management
- **Supporting Goals –** Improve O&M, Improve Institutional Support, Promote Multi-Benefit Projects

Extent of Benefit Area: Project would have local, regional, and systemwide benefits.

Potential to Provide Multi-Benefits:

- **Flood Damage Reduction Benefit –** Reducing peak flows would minimize property damages caused by flooding within the study area and minimize downstream property. Alleviating peak flood floods would also reduce the risk to public health and safety, and reduce flood damages to residences, businesses, and public infrastructure in the vicinity of the project area. Project would capture surface stormwater for conservation, conjunctive use, and increased water supply.
- **Ecosystem Restoration –** Project would enhance and protect environmental resources.
- **Water Supply –** Project would improve water quality by minimizing erosion and sedimentation, as well as assist in groundwater recharge of the local aquifer(s).
- **Recreation and Other Benefits –** None

Implementation Cost: Capital Construction: $11.2-13.7 million (South Fork Willow Creek), $10.3 – $12.6 million (Wilson Creek); Wilson Creek: $292,000 (South Fork Willow Creek), $178,000 (Wilson Creek)

Implementation Considerations:

- **Redirected Hydraulic Impacts –** Possible changes to timing of channel incision, channel form, and land uses on upper watershed sediment runoff.

- **Adverse Environmental Impact and Regulatory Issues –** Colusa Basin groundwater has elevated salt concentrations that may adversely affect yields of commonly grown crops.

- **Other**

Associated Studies

Wilson Creek Detention Facility Hydrogeologic Basin Evaluation.

References

H.T. Harvey & Associates. Colusa Basin Watershed Assessment – Final. December 15, 2008. Available: <http://132.241.99.23/SRCAF/library_doc/Colusa%20Basin%20Watershed%20Assessment%20(2008).pdf>. Accessed: May 10, 2011.

U.S. Bureau of Reclamation. Wilson Creek Detention Facility Hydrogeologic Basin Evaluation. Available: <http://www.glenncountywater.org/documents/CBDDWilsonCreekSOWforWeb.pdf>. Accessed: May 10, 2011

CH2MHILL. Benefit/Cost Analysis for Colusa Basin Drainage District Integrated Watershed Management Plan Feasibility Study Technical Memorandum. 2004. Available: < http://www.water.ca.gov/economics/downloads/Colusa/appendixc-b_c_analysis.pdf>. Accessed: May 10, 2011

1.11 Colusa Drain Improvements

Project Type: System Modifications

Location Information:

- **Region** – Upper Sacramento
- **Subregion** – Colusa Drain
- **Location –** Colusa Basin Drain extends from its junction with Willow Creek south to the vicinity of Colusa and then follows the alignment of the Reclamation District (RD) 108 Back Levee, terminating at the Knights Landing Outfall Gates on the Sacramento River in Yolo County
- **Community Setting –** Nonurban

Project Proponents:

- **Potential Non-Federal Lead Agency –** DWR, CBDD
- **Potential Lead Federal Agency –** To Be Determined
- **Potential Partners –** Colusa County Resource Conservation District (RCD), USDA
- **Contact Information –** Eugene Massa Jr., CBDD General Manager

Description:

- **Purpose –** The Colusa Basin Drain was original constructed to provide adequate drainage for agricultural production, not to provide minimum necessary conveyance for winter flood prevention. As agricultural production and volumes of applied irrigation water have expanded, the drain has also been shown to be undersized in places for handling summer irrigation return flows. According to the DWR, the typical pattern of flooding occurring along the Colusa Drain Basin is primarily the result of runoff from foothill streams during the winter and releases of irrigation water from rice fields during the summer. Original capacity was approximately 1,450 cfs with 1 foot of freeboard; but currently is about 2,100 cfs at Highway 20 and about 12,450 cfs at Knights Landing.

In addition, land has been put into agricultural production up to the western edge of the Colusa Basin Drain (canal), and the levees have been built along the western edge of the canal to protect agricultural lands. These levees may act to constrict the canal's capacity and thereby incrementally raise the canal water surface elevation in places.

- **Concept –** DWR (1962, 1964) prepared hydraulics models of the Colusa Drain Basin channel to serve as a basis for evaluating the flood benefits in terms of reduced inundation area resulting from a range of management actions: (1) improved drainage facilities from the Knights Landing Ridge Cut through the Yolo Bypass, (2) systems of levees along the Colusa Basin Drain, (3) flood control reservoirs in the western foothills, and (4) watershed management. DWR (1990) updated the evaluation of these alternatives, many of which are still under consideration, and added a fifth evaluation of enlarging the Knights Landing Ridge Cut.

  DWR first considered the potential benefits of constructed new and/or enlarged levees along the existing Colusa Basin Drain to create a maximum channel top width of 450 to 1,000 feet. DWR reevaluated the levee project, estimating it then to cost $76 million for protecting 180,000 acres, yielding a cost-benefit ratio of 0.19 over 50 years of the 100-year protection level project at an 8.875 percent discount rate. The levee protection alternative has generally been abandoned in favor of projects that use reservoirs on the foothill streams to detain floodwaters.

  Improvements to the Colusa Basin Drain will be discussed in the Integrated Watershed Management Plan. Updates to this (currently unpublished) Management Plan are available on the Colusa County RCD Web site. The goals and objectives in improving flood control described in the Assessment Report (Harvey, 2008) include:

  - Reduce flooding along the Colusa Basin Drain and other flood prone areas
  - Assess the status and functionality of degrading flood control infrastructure (e.g., drainage canals, ditches, canal banks, levees)
  - Find ways to allow floodwaters onto floodplains without damaging crops, homes, and infrastructure
  - Determine the cumulative effects of existing wetland and riparian restoration projects on flooding

- Protect banks/levees of ephemeral streams: reducing localized flooding

- Improve infiltration ability of flood-prone areas and natural drainages

- Identify (geographically) where natural channels have been removed (through land leveling, etc.) and identify its effect upon storm runoff and localized flooding

- Compensate farmers whose rice land is used for off-stream storage

- Develop and implement measures to control runoff in foothills, orchards, rice fields, rangelands, and on all other agricultural lands

The Colusa Basin Watershed Assessment report identifies several example projects that could address some of the stakeholder concerns. The watershed planning goals will not be formalized until the management plan is underway. Since the watershed planning goals will not be formalized until the management plan is underway, the following merely provides examples of a few potential projects. The purpose of this list is simply to provide preliminary examples of projects that could come out of an integrated planning process. This list includes: (1) Foothill Streams – Creek Bank Stabilization and Riparian Habitat Restoration Projects; (2) Oak Woodland Habitat Management; and (3) Wetland and Riparian Management and Restoration Projects.

- **Relation to SPFC Facilities –** Knights Landing Ridge Cut, Colusa Weir

Project Status: Conceptual

Applicable Management Action(s): System Modifications – Levees/Floodwalls/ Hydraulic Structures

Contribution to CVFPP Goals:

- **Primary Goal –** Improve Flood Risk Management

- **Supporting Goals –** Improve O&M, Improve Institutional Support, Promote Multi-Benefit Projects

Extent of Benefit Area: This project would likely have local, regional, and/or systemwide benefits.

Potential to Provide Multi-Benefits:

- **Flood Damage Reduction Benefit –** Improvements to the Colusa Basin Drain would reduce flooding in this area. Could take away peak flows and reduce physical flow constrictions. Currently, an unintentional lake forms due to inability to free flow into the Sacramento River.

- **Ecosystem Restoration –** Little to no benefits for ecosystem. Colusa Basin Drainage Canal is a major contributor of warm water into the Sacramento River, which has a detrimental effect on salmonids. The Colusa Basin Drain "attracts adult fish into an area where survival is unlikely and returns agricultural drain water of high temperature and poor quality into the Sacramento River" at Knights Landing (DFG, 2003). There are special-status wildlife species that are known to or that may occur in the valley foothill woodlands in the Colusa Basin Watershed sDo you uch as Cooper's hawk, Swainson's hawk (*Buteo swainsoni*), long-eared owl (*Asio otus*), etc., and common wildlife species found in this habitat. There is potential for riparian habitat restoration through revegetation. Will result in better water movement and volume.

- **Water Supply –** Could improve the water quality by identifying water quality issues and recommending water quality control measures for urban and rural areas. Educate the landowners to help control non-point source pollution and recommend/implement best management practices for agricultural and rangeland areas to reduce soil erosion and associated sediment loading into drainages.

- **Recreation and Other Benefits –** Hunting, boating, and fishing are among the most popular recreation activities in the Colusa Basin Watershed.

Implementation Cost: Not applicable

Implementation Considerations:

- **Redirected Hydraulic Impacts –** Improvements to the Colusa Drain may have hydraulic effects downstream from the drain and areas surrounding the basin.

- **Adverse Environmental Impact and Regulatory Issues –** There is a potential for a reduction of habitat and effect the water quality.

- **Other –** Conflicts with current land uses and surrounding agriculture. There may be ecosystem constraints to counties, also public opposition.

Associated Studies

To Be Determined

References

Colusa County Resources Conservation District. Final - Colusa Basin Watershed Assessment. Prepared by: H.T. Harvey & Associates. December 15, 2008.

Colusa County Resource Conservation District. Colusa Basin Watershed Management Plan website. Available: <http://www.colusarcd.org/nodes/projects/WatershedManagementPlan.htm>. Accessed: April 28, 2011.

1.12 Protect M&T Pumping Facilities

Project Type: System Modifications

Location Information:

- **Region** – Upper Sacramento
- **Subregion** – Downstream from Chico
- **Location** – Left bank of Sacramento River RM 192.8 +/-
- **Community Setting** – Nonurban

Project Proponents:

- **Potential Lead Non-Federal Agency** – To Be Determined
- **Potential Lead Federal Agency** – USACE
- **Potential Partners** – Sacramento River Conservation Area, Butte Creek Watershed Conservancy, Sacramento Valley Landowners Association, DWR, Department of Parks and Recreation, DFG, City of Chico, USFWS
- **Contact Information** – Mike Inamine, Sutter-Butte Flood Control Agency

Description:

- **Purpose** – The current meandering of the Sacramento River is resulting in the need for dredging of the river to keep the pump facilities operational, either the river or the pump intake needs to be relocated to allow for pumping without dredging. This agricultural pumping facility was relocated from Big Chico Creek to protect threatened and endangered anadromous fish populations and pumping requirements for adjacent agriculture, managed wetlands (federal, State, and private), and City of Chico wastewater facility without a significant effect upon river meander. As a result of natural riverine dynamics, future encroachment of a gravel bar will continue to exist causing a substantial threat to the operation of the pumping facility, the fish screens, and the outfall.
- **Concept** – A proposal to structure a process that will develop a long-term solution to meeting water needs of the beneficiaries of the

M&T/Llano Seco pumping facility while maintaining the natural river meander process in the Sacramento River. The proposal states that larger scale measures that address longer term, larger scale processes will likely provide more persistent results.

The short-term protection plan to protect the functionality and delivery of water supplies to the fish screen and pumping facility is to continue to maintain the position of the gravel bar to protect the facilities until a solution is in place. Continued removal of the gravel bar will be conducted until a long-term solution is set. Divers will continue to inspect the existing gravel bar annually and collect necessary data on the southern migration of sediment deposition. The long-term solution process will consist of gathering data, convening a Steering Committee composed of stakeholders and recognized experts, researching existing conditions of the river, understanding fluvial geomorphology, monitoring the gravel bar, gathering data from surveyors, hydrologists, and geotechnical engineers, and preparing a river model to assist in determining an appropriate long-term solution.

- **Relation to SPFC Facilities –** M&T/Llano Seco Pumping and Fish Screen Facility, City of Chico Wastewater Treatment Plant Outfall

Project Status: Reconnaissance

Applicable Management Action(s): System Modifications – Levees/Floodwalls/Hydraulic Structures

Contribution to CVFPP Goals:

- **Primary Goal –** Improve Flood Risk Management
- **Supporting Goals –** Improve O&M, Promote Ecosystem Functions, Improve Institutional Support, Promote Multi-Benefit Projects

Extent of Benefit Area: This project would have local and regional benefits.

Potential to Provide Multi-Benefits:

- **Flood Damage Reduction Benefit –** Protects necessary hard point in the area.
- **Ecosystem Restoration –** Project aims to reach goals of the CALFED Bay-Delta Program (CALFED) Ecosystem Restoration Plan and Anadromous Fish Restoration Plan for all salmonid species, connectivity to upstream spawning and rearing habitat in Butte and Big

Chico Creeks, which is essential to the sustainable populations of spring-run, winter-run, fall-run and late fall-run salmon and steelhead trout (*Oncorhynchus mykiss*).

- **Water Supply –** The project aims to provide continued assurance of a reliable water protect the M&T pumping facility that supplies water to the M&T Chico Ranch and Llano Seco Ranch.
- **Recreation and Other Benefits –** Possible effect on boating/navigation.

Implementation Cost: Minimum of $400,000 per dredging; approximately $5 million

Implementation Considerations:

- **Redirected Hydraulic Impacts –** River hydraulics and cover along the bank will be affected by the project since the project will alter bank configuration and structural features (e.g., riparian vegetation and placement of woody complexes), potentially affecting the quantity and quality of near-shore habitat for migrating juvenile steelhead and other listed fish species.
- **Adverse Environmental Impact and Regulatory Issues –** Removal of riparian vegetation from the riverbank would result in temporary loss of a source of State Recreation Area (SRA) cover for juvenile salmon, but will be replaced with additional riparian vegetation and woody materials to reduce homogeneity of the water velocity and provide cover for fish when flows are high.
- **Other**

Associated Studies

To Be Determined

References

M&T/Llano Seco Fish Screen Facility – Short-Term/Long-Term Protection Project. Summary Sheet.

Gallaway Consulting, Inc. M&T/Llano Seco Fish Screen Facility Short Term Protection Project Temporary Maintenance of Channel Alignment River Mile 192.5-R. Administrative Draft Environmental Assessment and Initial Study. October 2005.

M&T/Llano Seco Fish Screen Facility – Short-Term/Long-Term Protection Project, Phase II. Technical Memorandum Workshop #5 Summary. December 19, 2008.

1.13 Secure Meander Zones Along Upper Sacramento River Where Major Infrastructure is Threatened

Project Type: Floodplain Management

Location Information:

- **Region –** Upper Sacramento
- **Subregion –** Downstream of Chico
- **Location –** Red Bluff to Ord Ferry Reach
- **Community Setting** – Other

Project Proponents:

- **Potential Lead Non-Federal Agency** – DWR
- **Potential Lead Federal Agency –** USACE
- **Potential Partners –**CALFED, Sacramento River Conservation Area Forum (SRCAF), USFWS, DFG, Department of Parks and Recreation, Wildlife Conservation Board, The Nature Conservancy, Sacramento River Partners, and other nonprofit organizations and stakeholders
- **Contact Information –** To Be Determined

Description:

- **Purpose –** Meandering portions of the Sacramento River, particularly through the Red Bluff-to-Colusa reach, demonstrate the role of an active riverine process creating and maintain riparian habitats, such as water flow, erosion/deposition, lateral channel migration, and ecological succession. River meandering and avulsion create a mosaic of landscapes and vegetative diversity that is key to the wildlife habitat value of the system. The ability of the river to meander, avulse, and generate new floodplain surfaces is crucial to supporting diverse riparian habitats and healthy populations of riparian-dependent species.

  When not constrained by natural or man-made erosion-resistant banks, large alluvial meandering rivers have a tendency to migrate laterally (E. Larson, 2007).

The Sacramento River's "inner river zone" is a river alluvium that has experienced river channel migration in the recent past and is likely to experience channel movement in the near future; the area includes the 100-year meander belt and area of project bank erosion over the next 50 years.

- **Concept –** Government and nonprofit organizations have developed guidelines to ensure riparian habitat management along the river addresses the dynamics of the riparian ecosystem and the reality of the local agricultural economy. A detailed site assessment protocol has been established in Chico's Landing Restoration Management Plan Summary, which recommends detailed site assessments be routinely performed to characterize conservation properties and tailored to individual circumstances at each property.

  Public access is an issue of substantial concern in the study area with opinions expressed both for and against increased access. Public access is desired in the form of additional boat facilities and road access to the river or to and through public lands. Private landowners have concerns about the potential for increased trespassing. As a result, public access in certain areas will need to be carefully planned to strike a balance among recreation use, other human uses, landowner concerns, and programs for the protection and restoration of the dynamic Sacramento River system.

  The conflict between river channel movement and the need to protect adjacent human infrastructure (e.g., towns, bridges, water pumps) can be avoided through long-term planning efforts using process-based geomorphic simulation modeling to forecast potential long-term, landscape-level efforts of water management decisions on river meander migration (E. Larson, 2007).

- **Relation to SPFC Facilities –** Not applicable

Project Status: Conceptual

Applicable Management Action(s): Floodplain Management – Easements/Acquisitions

Contribution to CVFPP Goals:

- **Primary Goal –** Improve Flood Risk Management

- **Supporting Goals –** Improve O&M, Promote Ecosystem Functions, Promote Multi-Benefit Projects

Extent of Benefit Area: The project would likely have local and regional benefits.

Potential to Provide Multi-Benefits:

- **Flood Damage Reduction Benefit** – Project aims to decrease the risk of flood damage for infrastructure along the meandering Sacramento River.
- **Ecosystem Restoration –** Project will be able to help maintain and even restore the riparian ecosystem that provides habitat for hundreds of resident and migratory birds, fish, and wildlife species.
- **Water Supply –** Not applicable
- **Recreation and Other Benefits –** Additional new lands along the upper Sacramento River could be used for public road access, boating facilities, outreach areas (using signage, kiosks, nature center), camping facilities, bank fishing access, new fishing trails, hunting access, non-motorized trails and nature observation, picnics, and developed river parks. This area also provides a rich bed load of fine soil and nutrients in the extended flood zone that have enabled productive farming for miles along the broad river corridor.

Implementation Cost: Not applicable

Implementation Considerations:

- **Redirected Hydraulic Impacts –** Changes to the meandering river will alter flow path, but negative hydraulics impacts are uncertain.
- **Adverse Environmental Impact and Regulatory Issues –** Adverse environmental impacts to the ecosystem and communities will depend on project implementation methods. There may be a disruption to the ecosystem and existing habitat while securing the meander zones.
- **Other**

Associated Studies

To Be Determined

References

Larsen, E.W., Girvetz, E.H., and Fremier A. K. Landscape level planning in alluvial riparian floodplain ecosystems: Using geomorphic modeling to avoid conflicts between human infrastructure and habitat conservation. Landscape and Urban Planning, Volume 79, pg 388-346. 2007.

CALFED Bay-Delta Program website. Available: <http://www.science.calwater.ca.gov/pdf/eco_restor_sac_river.pdf> Accessed: April 29, 2011.

The Nature Conservancy (TNC). Sacramento River Public Recreation Access Study: Red Bluff to Colusa. January 28, 2003. Available <http://www.sacramentoriverportal.org/recreation/report.htm>. Accessed: April 29, 2011

1.14 Remove Sediment and Rehabilitate Structure, as Necessary, at Colusa Weir

Project Type: Operations and Maintenance

Location Information:

- **Region** – Upper Sacramento
- **Subregion –** Downstream from Chico
- **Location –** Colusa Weir and downstream from the weir
- **Community Setting** – Nonurban

Project Proponents:

- **Potential Lead Non-FederalAgency** – DWR
- **Potential Lead Federal Agency** – USACE
- **Potential Partners –** The Nature Conservancy (TNC), California State Parks
- **Contact Information –** To Be Determined

Description:

- **Purpose –** This area is a massive deposit center for sediment. Extensive sediment removal is necessary to restore the Colusa Bypass flood carrying capacity and to ensure proper operation of the flood control system. Sediment deposits have reduced the flow capacity of the bypass and the efficiency of the flood control system by forcing flows to remain in the Sacramento River. Deposits forming at the entrance to Colusa Bypass increases stage thresholds for flows entering the floodway, exacerbating flood risk in the main channel downstream from the entrance. It also affects flood conveyance, potentially causing backwater effects that could limit diversion of flood discharge into the bypass system. Colusa Weir is fundamental to flood control in the lower Sacramento Valley because it is the only major exit point for flood flows upstream from the channel constriction.

- **Concept –** Removal sediment along the Colusa Weir and downstream from the weir. Also, rehabilitate Colusa Weir.

The Colusa SRA Habitat Restoration & Tisdale Bypass Sediment Removal Project is to restore habitat on an estimated 139 total acres on the Ward Property within the Colusa Subreach, including 35 acres grassland, 11 acres oak savannah, and 93 acres riparian forest, as mitigation for impacts to riparian habitat caused by the clearing of Tisdale Bypass. Ensure habitat restoration will not affect flood flows within the Colusa Subreach.

- **Relation to SPFC Facilities –** Colusa Weir

Project Status: Conceptual for rehabilitation of structure. Sediment removal project under construction, March 2009 to December 2011.

Applicable Management Action(s): O&M – Dredging and Clearing

Contribution to CVFPP Goals:

- **Primary Goal –** Improve Flood Risk Management
- **Supporting Goals –** Improve O&M, Promote Ecosystem Functions, Improve Institutional Support, Promote Multi-Benefit Projects

Extent of Benefit Area: The project will have local and regional benefits.

Potential to Provide Multi-Benefits:

- **Flood Damage Reduction Benefit –** Removal of the deposits forming at the entrance of the Colusa Bypass would decrease flood risk in the main channel downstream from the entrance.
- **Ecosystem Restoration –** The Habitat Restoration portion of the project includes restoring and estimated 139 total acres on the Ward Property within the Colusa Subreach, including grasslands, oak savannah, riparian forest, and mitigation for impacts to riparian habitat.
- **Water Supply –** Would for more flow to go downstream, which may help those who depend on this water.
- **Recreation and Other Benefits –** None

Implementation Cost: To Be Determined

Implementation Considerations:

- **Redirected Hydraulic Impacts –** Hydraulic changes would have beneficial impacts.

- **Adverse Environmental Impact and Regulatory Issues –** Project may have little adverse environmental impact.
- **Other**

Associated Studies:

- Colusa SRA Habitat Restoration & Tisdale Bypass Sediment Removal Project (2008)
- Status of the Lower Sacramento Valley Flood-Control System within the Context of its Natural Geomorphic Setting (August 2008)

References

California Department of Water Resources (DWR). Final Report of the Flood Emergency Action Team.1997. Available: <http://www.water.ca.gov/historicaldocs/irwm/feat-1997/fcsib1g.html>. Accessed: May 6, 2011.

Sacramento River Conservation Area Forum. 2008. Available: < http://www.sacramentoriver.org/srcaf/publications/2008_SRCAF_Annual_Report.pdf> . Accessed: May 6, 2011

M. Singer, R. Aalto and L.A. James. Status of the Lower Sacramento Valley Flood-Control System within the Context of its Natural Geomorphic Setting. ASCE Natural Hazards Review. August 2008.

1.15 Construct Peak Overflow Detention Basins on Streams in Tehama County

Project Type: Additional Storage

- Location Information:
- **Region –** Upper Sacramento
- **Subregion –**Westside Tributaries
- **Location –** The County of Tehama is located in the Sacramento Valley midway between the city of Sacramento and the Oregon border. Tehama County encompasses an area of nearly 3,000 square miles and is divided by the Sacramento River, which flows through the county from north to south. Approximately 35 percent of the county is west of the Sacramento River and 65 percent is east. The county is bordered on the west by Trinity and Mendocino counties along the Pacific Coast Ranges, Shasta County on the north, Plumas County on the east along the ridgeline of the Sierra Nevada-Cascade Mountains, and on the south by Butte and Glenn counties
- **Community Setting –** Small Community (City of Corning, Pop. less than 8,000)

Project Proponents:

- **Potential Lead Non-Federal Agency –** Tehama County Flood Control & Water Conservation District
- **Potential Lead Federal Agency –** To Be Determined
- **Potential Partners –** City of Corning
- **Contact Information –** Ernie Ohlin, Deputy Director of Public Works – Water Resources, Tehama County

Description:

- **Purpose –** Tehama County has suffered major adverse flood impacts from Burch and Jewett creeks during flood events. They overflow and cause major overland sheet flow flooding of infrastructure, homes, etc. Construction of control structures to allow for peak flows to be discharged into detention basins would reduce flood impacts.

- **Concept –** The locations of the proposed detention basins have not yet been determined; however, potential benefits would include:
  - Alleviate peak flood flows, reduce the risk to public health and safety, and reduce flood damage to residences, businesses, and public infrastructure in the vicinity of the city of Corning
  - Assist in groundwater recharge of the local aquifer
  - Capture surface stormwater for conservation, conjunctive use, and increased water supply
- **Relation to SPFC Facilities –** To Be Determined

Project Status: Conceptual: The October 2006 Tehama County Flood Mitigation Plan identifies several actions that are recommended for implementation to mitigate the adverse impacts from flooding in Tehama County. Formulate a Flood Management Plan for Jewett and Burch creeks in the vicinity of Corning is one such action and includes consideration of detention storage as a possible action.

Applicable Management Action(s): Additional Storage – Floodplain (Transitory) Storage

Contribution to CVFPP Goals:

- **Primary Goal –** Improve Flood Risk Management
- **Supporting Goals –** Promote Multi-Benefit Projects

Extent of Benefit Area: Reducing peak flood flows and releasing them at a later time have local benefits and could apply regionally and statewide if controlled releases are coordinated with other downstream and upstream agencies.

- Potential to Provide Multi-Benefits
- **Flood Damage Reduction Benefit –** Reduce flooding locally by reducing peak flows.

  Reduce downstream flooding by conducting controlled releases of the retained water.
- **Ecosystem Restoration –** Creation of detention basins also creates open space and potential habitat for wildlife and native vegetation.

- **Water Supply –** Detention basins hold water up to a maximum of 30 days; therefore, depending on the soils underlying each detention basin, water will naturally seep to the ground while water is retained in the detention basin.

  Due to the fact that a detention basin will release the floodwaters over a longer period of time, there will be additional groundwater recharge occurring via streambed recharge.

  Water quality downstream will be improved since sediment and debris would collect in the basins.

- **Recreation and Other Benefits –** To Be Determined

Implementation Cost: Costs for completing the Flood Management Plan was estimated at approximately $300,000. No estimate for implementation/construction of the basins.

Implementation Considerations:

- **Redirected Hydraulic Impacts –** Detention basins would be emptied at a controlled rate to ensure that flows are maintained within the channel capacity. This would potentially improve flooding conditions downstream from the project.

- **Adverse Environmental Impact and Regulatory Issues –** Flood management actions, especially structural management actions, have the potential to adversely impact the environment while meeting other flood management goals. The impacts of this project have not yet been determined.

- Other

Associated Studies

To Be Determined

References

Drainage Study. Available: <http://www.civilsolutions.com/workspaces/tehama/report-total-04-06-updated-cover.pdf>

Secretary of the Army Civil Works Division Annual Report FY 07 South Pacific Division. Available:

<http://www.usace.army.mil/CECW/PID/Documents/annual_reps/fy07/SPD_fy07.pdf>

Tehama County Flood Mitigation Plan. Available: <http://www.tehamacountywater.ca.gov/fmp.htm>

1.16 Construct Peak Overflow Detention Basins on Streams in Glenn County

Project Type: Additional Storage

Location Information:

- **Region –** Upper Sacramento
- **Subregion –**Westside Tributaries
- **Location –** The County of Glenn is located in the Sacramento Valley midway between the city of Sacramento and Redding in Northern California. The city of Willows is located in western Glenn County along I-5, approximately 85 miles north of Sacramento
- **Community Setting –** Small Community (City of Willows, Pop. Less than 7,000) and surrounding rural area

Project Proponents:

- **Potential Lead Non-Federal Agency –** Colusa Basin Drainage District
- **Potential Lead Federal Agency –** U.S. Department of the Interior
- **Potential Partners –**Bureau of Reclamation (Reclamation), DWR
- **Contact Information –** Ernie Ohlin, Deputy Director of Public Works – Water Resources, Tehama County

Description:

- **Purpose –** The CBDD is currently planning two floodwater detention facilities: one west of Willows on South Fork Willow Creek to reduce flooding in Willows, and one in the Wilson Creek area. In addition to these two sites, the CBDD has other sites in Glenn and Colusa counties (e.g., Funks Creek reservoir) targeted for remediation measures, including, but not limited to, detention facilities.
- **Concept –** The South Fork Willow Creek Basin would be located in the foothills approximately 12 miles west of Willows. The basin would detain stormwater from upper Willow Creek, which would then be released after storm flows recede. The proposed embankment (dam) would be approximately 70 feet high, including 10 feet of freeboard

above the 100-year water surface elevation. The embankment cross section would range from 200 to 550 feet wide at the bottom and up to 20 feet wide at the top. The total length of the embankment would be roughly 600 feet. The detention basin would accommodate up to 5200 acre-feet of storage and would inundate approximately 305 acres during the 100-year storm.

As designed, the South Fork Willow Creek detention basin is anticipated to reduce peak flow in the combined Willow Creek and Wilson Creek channels at Willows (at flood stages, Willow Creek and Wilson Creek are practically combined channels) by approximately 14 percent for the 100-year flood and 11 percent for the 5-year flood. Modeling suggests the flooded area would reduce as much as 25 percent for the 100-year flood and 47 percent for the 5-year flood.

The proposed Wilson Creek detention basin would be located and designed to operate in the same manner as the South Fork Willow Creek detention basin. The embankment would be 55 feet high (10 feet of freeboard above the 100-year water surface elevation), and the cross section would be approximately 300 feet wide at the bottom and 20 feet wide at the top. The total length of the embankment would be roughly 3,500 feet, and the basin would hold up to 2,300 acre-feet and inundate approximately 163 acres during the 100-year design inflow. The Wilson Creek detention basin is anticipated to reduce peak flow in the combined Willow Creek and Wilson Creek channels at Willows by approximately 7 percent for the 100-year flood and 6 percent for a 5-year flood. Modeling suggests the flooded area in the vicinity of Willows would reduce as much as 13 percent for the 100-year flood and 26 percent for the 5-year flood.

Potential benefits of the two basins would include:

- Alleviate peak flood flows, reduce the risk to public health and safety, and reduce flood damage to residences, businesses and public infrastructure in the vicinity of the city of Corning
- Assist in groundwater recharge of the local aquifer
- Capture surface stormwater for conservation, conjunctive use, and increased water supply

- **Relation to SPFC Facilities –** To Be Determined

Project Status: The South Fork Willow Creek Detention Facility is completely designed, has nearly all permits secured and has a bid packet ready for distribution as soon as funding becomes available. The Wilson Creek Detention Facility still requires further study to determine its feasibility.

Applicable Management Action(s): Additional Storage – Floodplain (Transitory) Storage

Contribution to CVFPP Goals:

- **Primary Goal –** Improve Flood Risk Management
- **Supporting Goals –** Promote Multi-Benefit Projects

Extent of Benefit Area: Reducing peak flood flows and releasing them at a later time have local benefits and could apply regionally and statewide if controlled releases are coordinated with other downstream and upstream agencies.

Potential to Provide Multi-Benefits:

- **Flood Damage Reduction Benefit –** Reduce flooding locally by reducing peak flows.
- Reduce downstream flooding by conducting controlled releases of the retained water.
- **Ecosystem Restoration –** Creation of detention basins also creates open space and potential habitat for wildlife and native vegetation.
- **Water Supply –** Detention basins hold water up to a maximum of 30 days; therefore, depending on the soils underlying each detention basin, water will naturally seep to the ground while water is retained in the detention basin.

  Due to the fact that a detention basin will release the floodwaters over a longer period of time, there will be additional groundwater recharge occurring via streambed recharge.

  Water quality downstream will be improved since sediment and debris would collect in the basins, and erosion would be minimized due to controlled discharge.
- **Recreation and Other Benefits**

Implementation Cost: Capital Construction: $11.2 – 13.7 million (South Fork Willow Creek), $10.3 – $12.6 million (Wilson Creek); Wilson Creek: $292,000 (South Fork Willow Creek), $178,000 (Wilson Creek)

Implementation Considerations:

- **Redirected Hydraulic Impacts –** Detention basins would be emptied at a controlled rate to ensure that flows are maintained within the channel capacity. This would potentially improve flooding conditions downstream of the project.

- **Adverse Environmental Impact and Regulatory Issues –** Colusa Basin groundwater has elevated salt concentrations that may adversely affect yields of commonly grown crops.

- **Other**

Associated Studies

Colusa Basin Drainage District Watershed Management Plan (Not yet released)

References

Glenn County general plan Volume II. Available: <http://gcplanupdate.net/_documents/docs/VOLUME%20II-ISSUES-1.pdf>

Colusa Basin Drainage District Integrated Water Management Plan presentation. Available: <http://colusagroundwater.ucdavis.edu/040109_Glenn_Colusa%20Presentations%20pdf/Massa%20Presentation%20-%20CBDD.pdf>

Wilson Creek detention Basin Hydrogeologic Evaluation. Available: <http://www.glenncountywater.org/documents/CBDDWilsonCreekSOWforWeb.pdf>

Colusa Basin Watershed Assessment. Available: <http://www.colusarcd.org/nodes/projects/ColusaBasinWatershedAssessmentMainPage.htm>

1.17 Gravel Augmentation at Cottonwood Creek

Project Type: Ecosystem Functions

Location Information:

- **Region –** Upper Sacramento
- **Sub-region –** Eastside/Westside Tributaries
- **Location –** North Fork Cottonwood Creek, located between 9,600 and 10,000 feet in elevation within the White Mountains
- **Community Setting –** Nonurban area

Project Proponents:

- **Potential Lead Non-Federal Agency –** National Forest Service (NFS)
- **Potential Lead Federal Agency –** USFWS
- **Potential Partners –** DFG
- **Contact Information –** Erin Lutrick

Description:

- **Purpose –** Improve spawning habitat within the North Fork Cottonwood Creek, for the federally endangered Paiute cutthroat trout (*Oncorhynchus clarki seleniris*).
- **Concept –** The North Fork Cottonwood Creek Gravel Augmentation Project would improve spawning habitat by adding gravel within an approximately 2-mile section of North Fork Cottonwood Creek. Up to 3 cubic yards of weed-free rounded gravel from ½ inch to 1 inch in diameter would be delivered by truck to a stockpile site above the Cottonwood Creek 4WD route, and transported from there to the project site by pack stock, and stockpiled in small piles in the vicinity of the creek.

  The gravel would be placed in the creek by hand, using a standard shovel and buckets at up to 25 individual sites, until enough gravel has been placed to adequately provide for spawning habitat (approximately 3 inches deep, in areas ranging from 5 to 10 square feet at each site). Implementation of the project is expected to be completed within 5 days, and would occur during the late summer/early fall months, outside the spawning period for the Paiute cutthroat trout.

Monitoring would occur during the next several years, and follow-up work would occur as needed. It is anticipated that additional gravel augmentation would be needed within 10 to 12 years, as gravel becomes embedded or washed downstream and unavailable as spawning habitat.

- **Relation to SPFC Facilities –** Not applicable.

Project Status: Gravel Augmentation has been completed. No follow-up monitoring has occurred due to insufficient funding.

Applicable Management Action(s): Ecosystem Functions

Contribution to CVFPP Goals:

- **Primary Goal –** Not applicable
- **Supporting Goals –** Promote Ecosystem Functions

Extent of Benefit Area: Local increase in trout population.

Potential to Provide Multi-Benefits:

- **Flood Damage Reduction Benefit**
- **Ecosystem Restoration –** This project is consistent with management direction in the *Inyo National Forest Land and Resource Management Plan* (1988) with regards to Threatened and Endangered fish:
  - Rehabilitate and maintain essential habitat for these species according to the species' recovery plans and Memoranda of Understanding with the DFG and the USFWS.
  - Provide high-quality habitat for threatened and endangered fish species based on the results of habitat capability model analyses.
- **Water Supply**
- **Recreation and Other Benefits**
  - Increased fish populations could eventually lead to increased fishing tourism.

Implementation Cost: Initial project costs estimated at approximately $21,000.

Implementation Considerations:

- **Redirected Hydraulic Impacts**
- **Adverse Environmental Impact and Regulatory Issues –** The Paiute cutthroat trout were transplanted in this creek as a refuge for their native habitat in the Carson-Iceberg Wilderness. Since Cottonwood Creek is not their native habitat, a small potential exists for negative impacts on the local ecosystem once the cutthroat trout populations have sufficiently increased. It has been determined that these potential negative impacts are offset by the positive impacts of saving an endangered species from possible extinction.
- **Other**

Associated Studies

Due to funding issues, no follow-up studies have been completed for this project.

References

Article on project. Available: <http://yubanet.com/regional/Forest-Service-is-Seeking-Comments-on-a-Proposal-to-Improve-Spawning-Habitat-in-the-North-Fork-of-Cottonwood-Creek_printer.php>

Decision Memo: North Fork Cottonwood Creek Gravel Augmentation Project. Provided by Erin Lutrick

1.18 Stabilize Sycamore Creek Erosion Through Construction of Grade Control Structures

Project Type: System Modifications – Levees/Floodwalls/Hydraulic Structures

Location Information:

- **Region –** Upper Sacramento
- **Subregion –** Eastside/Westside Tributaries
- **Location –** Sycamore Creek, a tributary of Mud Creek. Levees on the left bank of Mud Creek extend upstream along Highway 99 to nearly the mouth of Sycamore Creek
- **Community Setting –** Urban

Project Proponents:

- **Potential Lead Non-Federal Agency –** DWR
- **Potential Lead Federal Agency –** To Be Determined
- **Potential Partners –** TNC
- **Contact Information –** To Be Determined

Description:

- **Purpose –** In recent years, significant erosion has occurred of the bed and bank on the lower reaches of Sycamore Creek, both directly at and just below its confluence with the Diversion Channel from Big Chico Creek. The channel, before the addition of floodwaters, was a relatively small stream with no significant scour holes or erosion into the underlying "fanglomerate" geologic structure. Scour and erosion is evident in an originally buried sewer pipe being exposed and scour at several bridges downstream of Cohasset Road. All such erosion is taking place in the areas of Mud Creek and its tributary Sycamore Creek that are far upstream from the areas of these creeks affected by the backwater of the Sacramento River. With the relatively narrow levees along Mud Creek, sediment carried by the stream has no place to go besides settle in the bottom of the flood control channel. Due to levees on both sides of the channel, and added sediment from channel erosion upstream, this is perhaps most dramatic on Mud Creek, beginning from the reach between Meridian Road and Sacramento Avenue, and continuing to Big Chico Creek. Depending on the storm, sediment may either be deposited in the channel, if the river is at high stage and the creek(s) have the discharge necessary to transport sediment. Another possibility is if the river is at a lower stage, the creeks may sluice this sediment down to where it meets the river backwater.

- **Concept –** Important strategy in the protection and enhancement of rearing habitat for anadromous fish and riparian floodplain vegetation is the selective removal or realignment of levees, berms, revetment and other flood control features at the confluence of Mud Creek and Big Chico Creek with the Sacramento River Level. Local landowners have indicated they would support a more naturalized channel design if it ensured an increase in floodway capacity. Based on a study, the following conservation actions have been recommended:
  - Establish conservation programs with willing landowners adjacent to Mud Creek and Big Chico Creek within the Sacramento River Conservation Area. The Nock and Singh parcels are priority acquisitions for several reasons.
  - Restore landforms to improve floodway capacity and channel-floodplain connectivity.
  - Restore native plant communities to improve floodplain habitat.
  - Ensure long-term management and coordinated conservation ownership.
- **Relation to SPFC Facilities –** Not applicable

Project Status: Feasibility Study (unconfirmed)

Applicable Management Action(s): System Modifications: Bypasses

Contribution to CVFPP Goals:

- **Primary Goal –** Improve Flood Risk Management
- **Supporting Goals –** Improve O&M, Promote Ecosystem Functions

Extent of Benefit Area: Project would have local and regional benefits.

Potential to Provide Multi-Benefits:

- **Flood Damage Reduction Benefit –** Increase flood capacity, improve floodway capacity, improve channel floodplain connectivity for anadromous fish use, and would not cause undesirable flooding on downstream parcels. Important physical processes that create and maintain natural channel and bank conditions would be restored including sediment transport, channel erosion and deposition, and increased temporal and spatial connection of the creek with the floodplain during times of high flow by alleviating the scour and debris problem in the tributaries of Mud Creek (including Sycamore Creek), and prevent backwater from the Sacramento River

- **Ecosystem Restoration –** Juvenile Chinook salmon of all races (spring-, fall-, late fall-and winter-run) and steelhead trout, as well as non-game fish species, including Sacramento sucker (*Catostomus occidentalis*), Sacramento pike-minnow (*Ptychocheilus grandis*), hardhead (*Mylopharodon conocephalus*), hitch (*Lavinia exilicauda*), tule perch (*Hysterocarpus traskii*), and Sacramento splittail have been documented rearing in the tributaries flowing through or near the study area. The entire confluence area may be extremely important as rearing habitat for juvenile salmonids and restoration at this site may be highly beneficial and cost effective. The project would restore riparian areas which provide productive breeding grounds and offer over-wintering and migration stopover areas for avian species. This area presents excellent opportunities for protecting and restoring habitat critical for anadromous fish, neotropical migrant bird populations, and riparian forest communities.

  The site has deep alluvial soil with natural drainage features, making it ideal for riparian forest restoration. A variety of native riparian vegetation communities may be restored based on the soil conditions and the needs of flood managers.

- **Water Supply –** Project will allow for more groundwater recharge and supply.

- **Recreation and Other Benefits –** Possible location for lineal park along the length of Sycamore Creek to the Sacramento River.

Implementation Cost: To Be Determined

Implementation Considerations:

- **Redirected Hydraulic Impacts –** This project would alter the hydrologic conditions of this area, changing landforms and key hydro-geomorphic processes from its natural conditions. The hydrographs of the un-dammed tributaries are relatively natural and intact, providing a sound basis for restoration efforts in this area. The natural hydrographs of the tributaries provide the temporal and spatial temperature regime that native aquatic species have evolved with.

- **Adverse Environmental Impact and Regulatory Issues –** Concern for fish and wildlife is related to the stranding of up-migrating adult salmonids and some concern for decreases in riparian vegetation in Bidwell Park.

- **Other**

Associated Studies

To Be Determined

References

Ginney, Eric. Restoration Opportunities at Tributary Confluences: Critical Habitat Assessment of the Big Chico Creek/Mud Creek/Sacramento River Confluence Area. A Nature Conservancy Sacramento River Project. December 2001. Available: <http://www.sacramentoriverportal.org/big_chico/1_40.pdf>. Accessed: April 20, 2011

Big Chico Creek Watershed – Existing Management Plan. 2006. Available by search: <http://www.sacramentoriver.org/SRCAF/index.php>. Accessed April 20, 2011

Sacramento River Watershed Program. 2010. Available: <http://www.sacriver.org/documents/2010/Roadmap/Eastside_BigChico.pdf>. Accessed April 20, 2011

Maslin, Paul. Environmental Effects of the Big Chico Creek Flood Diversion. Available by search: < http://www.sacramentoriver.org/SRCAF/index.php>. Accessed April 20, 2011

1.19 Rehabilitate Chico Creek Diversion Structure

Project Type: System Modifications

Location Information:

- **Region** – Upper Sacramento
- **Subregion** – Eastside/Westside Tributaries
- **Location** – Chico Area
- **Community Setting** – Urban

Project Proponents:

- **Potential Lead Non-Federal Agency** – DWR
- **Potential Lead Federal Agency** – USACE
- **Potential Partners** – Butte County Public Works
- **Contact Information** – To Be Determined

Description:

- **Purpose** – Big Chico Creek diversion structure helps reduce flood risk in Chico and local transportation facilities. Diversion structures on the eastern side of Chico, Big Chico Creek, and Lindo Channel divert excess flows through a diversion channel to Sycamore Creek. These structures include the Big Chico Creek Gates, Lindo Channel Gates, and the Sycamore Weir. The diversion channel, about 2 miles long, has a design capacity of 8,500 cfs and has a levee along the left bank.

- **Concept** – The project potentially includes the unimproved channels of Big Chico Creek and Lindo Channel that lie between the diversion structure and the Sacramento River.

  Channel improvements and levees extend along both banks of Sycamore Creek, Sheep Hollow, and Mud Creek. About 20 miles of levee are located along these channels, downstream from the diversion channel. Levees line portions of the diversion channel. The design capacity of these levees at their upstream end on Sycamore Creek is 10,000 cfs with 3 feet of freeboard. Sheep Hollow (with a design capacity of 1,400 cfs) and Dry Creek (with a design capacity of 500 cfs) enter Sycamore Creek about 1.8 miles upstream from the Sycamore Creek and Mud Creek confluence. At the confluence, Sycamore Creek has a design capacity of 11,000 cfs and Mud Creek has a capacity of 5,500 cfs. While the design capacity of Mud Creek is 15,000 cfs for most of its length, portions of the channel have a capacity of 13,000 cfs.

- **Relation to SPFC Facilities –** Big Chico Creek Gates, Lindo Channel Gates, Sycamore Weir

Project Status: Conceptual

Applicable Management Action(s): System Modifications – Levees/Floodwalls/Hydraulic Structures

Contribution to CVFPP Goals:

- **Primary Goal –** Improve Flood Risk Management
- **Supporting Goals –** Improve O&M, Promote Ecosystem Functions, Improve Institutional Support, Promote Multi-Benefit Projects

Extent of Benefit Area: This project has local and regional benefits.

Potential to Provide Multi-Benefits:

- **Flood Damage Reduction Benefit –** Reduce flood risk in Chico and local transportation facilities.
- **Ecosystem Restoration –** Unknown
- **Water Supply –** Unknown
- **Recreation and Other Benefits –** Unknown

Implementation Cost: To Be Determined

Implementation Considerations:

- **Redirected Hydraulic Impacts –** To Be Determined
- **Adverse Environmental Impact and Regulatory Issues –** Flood management actions, especially structural management actions, have the potential to adversely impact the environment while meeting other flood management goals. The impacts of this project have not yet been determined.

- **Other**

Associated Studies

None

References

California Department of Water Resources. Central Valley Flood Management Planning Program (FloodSAFE). State Plan of Flood Control Descriptive Document. November 2010. Available: < http://www.water.ca.gov/cvfmp/documents.cfm >. Accessed: May 6, 2011

1.20 Deer Creek Levee Setback and Environmental Enhancement Project, Lower Deer Creek Flood Reduction and Fisheries Restoration Project

Project Type: System Modifications - Bypasses

Location Information:

- **Region –** Upper Sacramento
- **Subregion –** Eastside/Westside Tributaries
- **Location** – Deer Creek, a tributary off the middle reach of the Sacramento River, is located near Nevada City and is home to floodplain habitats that have been identified as biological "hotspots" because they provide vital habitat for fish and wildlife. The project is located on the eastern side of Tehama County, near the town of Vina
- **Community Setting** – Nonurban

Project Proponents:

- **Potential Lead Non-Federal Agency** – Deer Creek Watershed Conservancy
- **Potential Lead Federal Agency** – USACE
- **Potential Partner**s – Wildlife Conservation Board, DFG, Tehama County Flood Control and Water Conservation District (WCD), U.S. Department of Transportation (USDOT), Four Pumps Program, National Marine Fisheries Service (NMFS), USFWS
- **Contact Information** – Holly Savage

Description:

- **Purpose –** Portions of levees constructed by USACE in 1948 to convey flows up to 21,000 cfs may not actually have been built to the 21,000 cfs capacity. Modeling results of existing conditions suggest that portions of the existing levee system are overtopped as low as 10,000 cfs.

  Reconstructing and setting back the levee on both sides of the stream would increase the floodplain and increase the transitory storage capacity, restore channel form and function to improve O&M and facilitate flood damage reduction, remove barriers to fish passage, set back levees to connect rivers to floodplains, restore channel alignment, encourage natural physical geomorphic processes including channel migration and sediment transport, protect critical infrastructure corridors from flood waters (MA-069). This project is an effort to respond to the flooding and habitat problems in lower Deer Creek and explore the concept of deliberately using the floodplain of Deer Creek to accommodate part of the flood flows in a controlled fashion. With careful planning and adequate protections for vulnerable property and infrastructure, this project will seek to reduce flood flows and allow the channel to reestablish some of its irregular, hydraulically rough, and ecologically complete pre-levee condition.

- **Concept** – This plan includes developing performance measures; conduct adaptive management experiments; advance process understanding; establish integrated science programs in complicated field settings, compare effectiveness of different restoration strategies; coordinate and extend existing monitoring; and take advantage of existing data. Key milestones include the following:

  - **Phase I** – Chartering with Stakeholders (May 31, 2004); Assembling/Reviewing Existing Data/Information (June 30. 2004); Monitoring Plan Development and Initiation (April 16, 2007); Workshop with Participants/Stakeholders/Agencies (Ongoing) Preliminary Modeling Setup (May 30, 2007); Collection of Additional Data Hydrologic/Hydraulic Modeling Evaluation of Preliminary Scenarios Hydrologic/Hydraulic Analyses for Fluvial Geomorphology Review of Project Elements Versus Conceptual Model Select Alternatives (March 19, 2008); Workshop Alternatives and Evaluation: Technical Advisory Committee (TAC) Meeting – July 7, 2008 Conferences and Other Meetings (Ongoing); Document Alternatives and Monitoring – Feasibility/Monitoring Report (August 15, 2008)

  - **Phase II –** Conceptual Design of Initial Implementation Project Elements Conceptual Design of Selected Alternatives (September 19. 2008) Public Presentation/Workshop of Conceptual Design (July 8, 2008) Final Report/End of Project (January 31, 2009) This project is a direct link to milestones for the Ecosystem Restoration Plan (ERP) Multi-Species Conservation Strategy for the Sacramento River Basin Ecological Processes:

  - **Milestone 59 –** Develop floodplain management plans, including feasibility studies to construct setback levees, to restore and improve opportunities for rivers to inundate their floodplain on a seasonal basis for at least one tributary within each of the Ecological Management Zones (EMZ) in the Sacramento River Basin.

- **Milestone 64 –** Restore 2 miles of the 10-mile target of riparian habitat restoration along the lower reaches of the Deer Creek tributary.

- **Relation to SPFC Facilities –** Not applicable

Project Status: Design

Applicable Management Action(s): System Modifications: Setback Levees

Contribution to CVFPP Goals:

- **Primary Goal –** Improve Flood Risk Management

- **Supporting Goals –** Improve O&M, Promote Ecosystem Functions, Improve Institutional Support, Promote Multi-Benefit Projects

Extent of Benefit Area: This project would likely have local, regional, and systemwide benefits.

Potential to Provide Multi-Benefits:

- **Flood Damage Reduction Benefit –** This project will investigate the feasibility of providing a higher level of flood protection (up to 26,300 cfs, the 100-year flow) by further setting back and/or raising the levees, thereby increasing the level of flood protection and reducing the risk of future levee failure from overtopping and/or lateral scour.

- **Ecosystem Restoration –** Fish passage improvements (steelhead, spring-run and fall-run Chinook) by replacing the existing dam with a seasonal structure and may also increase the deposition of spawning gravel. The project could also expand the riparian zone providing a larger and more continuous corridor by setting-back levees.

- **Water Supply –** There will be groundwater recharge.

- **Recreation and Other Benefits –** This project includes extended livestock exclusion with setback levees, and sediment deposition from decreased flow velocities resulting from the growth of riparian vegetation.

Implementation Cost: $17,370,888

Implementation Considerations:

- **Redirected Hydraulic Impacts –** The Deer Creek Floodplain Restoration Project will alter the hydraulics for the project area through expansion of the floodplain and removal of the levee setback. Flow during major flood events will not be obstructed by the levee setback and will continue to flow throughout the Deer Creek floodplain.
- **Adverse Environmental Impact and Regulatory Issues –** Not applicable

Associated Studies

To Be Determined

References

American Rivers. 2010 Orvis Conservation Grant Project: Sacramento River – Deer Creek. Available: < http://www.americanrivers.org/our-work/restoring-rivers/floods-floodplains/orvis-conservation-grant-sacramento.html>. Accessed on April 19, 2011.

Sacramento River Conservation Area Forum – Project Tracker. Available: < http://www.sacramentoriver.org/ProjectTrak/ProjectTrack_Details.aspx?var1=139>. Accessed on April 18, 2011

American Rivers. Deer Creek Floodplain Restoration. Available: <http://www.americanrivers.org/our-work/water-supply/storage-flows/deer-creek-floodplain-rest.html>. Accessed on April 19, 2011

1.21 Remove Sediment and Rehab Structure as Necessary at Tisdale Weir

Project Type: Operations and Maintenance

Location Information:

- **Region –** Upper Sacramento
- **Subregion –** Sutter Bypass/Tisdale Bypass
- **Location –** Tisdale Weir
- **Community Setting –** Nonurban

Project Proponents:

- **Potential Lead Non-Federal Agency** – DWR
- **Potential Lead Federal Agency** – USACE
- **Potential Partners** – To Be Determined
- **Contact Information** – To Be Determined

Description:

- **Purpose –** Tisdale Weir and Bypass are crucial to the security of the Colusa and Sutter Basins. It provides relief of major flood flows in the main stem of the Sacramento River eastward into the Sutter Bypass. Tisdale Weir sends water into the Tisdale Bypass in Sutter County. There is a serious sediment problem in this area that can cause restriction to flood flows. Debris impedes flow into the Tisdale Bypass, which results in unnecessarily high Sacramento River flows and potential flood risk. Without sedimentation control, the risk of overstressing levees and extensive flood damage increase yearly.

  DWR spent approximately $5 million to remove sediment accumulated at the mouth of Tisdale Weir. In addition, the State is constructing an $8 million bridge to replace the structure currently across the weir – an ancient wood structure with footings so close together it traps river debris and blocks the flow into the bypass. The old bridge reduced weir capacity to 22,000 cfs from its design capacity of 33,000 cfs. The effect will be a reduction of pressure on the Sacramento River levees that protect the Meridian and Robbins basins from flooding (2008).

- **Concept –** Remove approximately 2.5 million cubic yards from the Tisdale Bypass in summer 2007. Construct a bridge to replace the structure currently across the Tisdale Weir.

- **Relation to SPFC Facilities** – Tisdale Weir

Project Status: Completed or Construction (project status is unclear)

Applicable Management Action(s): O&M – Dredging and Clearing

Contribution to CVFPP Goals:

- **Primary Goal –** Improve Flood Risk Management

- **Supporting Goals –** Improve O&M, Improve Institutional Support, Promote Multi-Benefit Projects

Extent of Benefit Area: The project has local, regional, and systemwide benefits.

Potential to Provide Multi-Benefits:

- **Flood Damage Reduction Benefit –** Removing sediment and improving the Tisdale Weir would alleviate the threat to public safety and the potential liability for substantial damages from backwater effects of restricted flood flows.

- **Ecosystem Restoration** – None

- **Water Supply –** None

- **Recreation and Other Benefits –** None

Implementation Cost: Estimated $13 million

Implementation Considerations:

- **Redirected Hydraulic Impacts –** None. Hydraulic changes would have beneficial impacts.

- **Adverse Environmental Impact and Regulatory Issues –** No adverse affects.

Associated Studies

None

References

Sutter County Newsletter. 2008. Available: <http://www.co.sutter.ca.us/pdf/news/Flood_Aware_2008.pdf>. Accessed: May 10, 2011.

California Department of Water Resources. Report of Activities of the Department of Water Resources. 2006. Available: < http://www.cvfpb.ca.gov/meetings/2006/04-06Item5DWRreport.pdf>. Accessed: May 10, 2011.

1.22 Protect Woodson Bridge Hard Point

Project Type: Floodplain Management

Location Information:

- **Region –** Upper Sacramento
- **Subregion –** Upstream of Chico
- **Location –** Tehama County between, Tehama County Highway A9 Bridge (Woodson Bridge).
- **Community Setting** – Small Community

Project Proponents:

- **Potential Lead Non-Federal Agency** – DWR
- **Potential Lead Federal Agency –** USACE
- **Potential Partners –** DFG, Tehama County, State Parks, TNC, SRCAF, USFWS
- **Contact Information** – Patricia Bratcher, DFG

Description:

- **Purpose –** Woodson Bridge State Recreation Area is susceptible to renewed bank erosion since the removal of the Palisades Demonstration Bank Protection Project on the Sacramento River since 1997. This area has major erosion problems. If no action taken, it is estimated about 40 acres will be eroded in the next 25 years (DWR, 1998).

  The unleveed reach of the Sacramento River has an active meandering bed with wide floodplains. Upstream from Woodson Bridge, extensive existing rock protection on both channel banks maintains the river's alignment through the bridge and prevents erosion. This area has potential for restoration habitat, bank rock removal, bank protection, and reconnection of Kopta Slough to the main channel.

  This project is part of the Kopta Slough Flood Protection and Habitat Restoration Project under the project element "Protect West Abutment of Woodson Bridge and City of Corning Sewer Outfall"

- **Concept –** Four options have been developed for erosion protection at Woodson Bridge. The protection options included no site improvements, bendway weirs with bank vegetation, low berm with upper bank vegetation, spur dikes with upper bank vegetation, and bank armor with upper bank vegetation.

- **Relation to SPFC Facilities –** None

Project Status: Conceptual

Applicable Management Action(s): Floodplain Management – Floodproofing

Contribution to CVFPP Goals:

- **Primary Goal –** Improve Flood Risk Management

- **Supporting Goals –** Improve O&M, Promote Ecosystem Functions

Extent of Benefit Area: Project would have local and regional benefits.

Potential to Provide Multi-Benefits:

- **Flood Damage Reduction Benefit –** Goal of the project is to reduce flood damage to protect public resources.

- **Ecosystem Restoration –** Project would help restore habitat and ecosystem functions through restoring natural fluvial and floodplain process.

- **Water Supply –** None

- **Recreation and Other Benefits –** Project would protect the existing recreational facilities such as a boat launch ramp for water sports. There are currently nature-related activities, hiking, and picnicking in this area.

Implementation Cost: $973,000 for spur dikes, $1.14 million for bendway weirs, $1.43 million for bank armor, and $2.66 million for low berm

Implementation Considerations:

- **Redirected Hydraulic Impacts –** Project would interrupt natural channel migration and associated erosion and deposition.

- **Adverse Environmental Impact and Regulatory Issues –** No impact to sensitive plant species. There may be impacts to the erosion of mature riparian forest plant communities, in which impacts can be mitigated. There might also be impacts on animal and riverine aquatic habitat that depend on erosion, channel movement and/or shade.

Associated Studies

Kopta Slough Flood Damage Reduction and Habitat Restoration Project Feasibility Study Proposal (2008)

References

Response to E-mail Request by Stuart Edell, Upper Sacramento Work Group Subcommittee, Objectives Development, Memorandum. October 28, 2010.

California Department of Water Resources (DWR). Hydraulic Analysis, Conceptual Design, and Preliminary Cost Estimate for the Kopta Slough Flood Damage Reduction and Habitat Restoration Study on the Sacramento River, RM 216 to RM 244. Tehama County, CA. December 28, 2009.

DWR. Woodson Bridge State Recreation Area Long-term Solutions Study – Working Draft. November 1998.

Sacramento River Conservation Forum Website. Available: <http://www.sacramentoriver.org/srcaf/index.php?id=kopta>. Accessed: May 5, 2011

1.23 Acquisition and Complete Restoration of Prospect Island

Project Type: Floodplain Management

Location Information:

- **Region** – Delta
- **Subregion** – Not applicable
- **Location** – Located in the North Delta in the Cache Slough Complex, at the southern end of the Yolo Bypass
- **Community Setting** – Nonurban area

Project Proponents:

- **Potential Lead Non-Federal Agency** – DWR
- **Potential Lead Federal Agency** – USFWS
- **Potential Partners** – Port of West Sacramento, CALFED Bay-Delta Program, DFG, Nonprofit environmental organizations
- **Contact Information -** To Be Determined

Description:

- **Purpose** – Restore the island to intertidal and appropriate subtidal habitat for the benefit of native fish and improved aquatic ecosystem function.

  Prospect Island restoration objectives are:

  - Create habitat suitable for federally listed threatened delta smelt (*Hypomesus transpacificus*) and proposed threatened Sacramento splittail.
  - Develop feeding, cover, and resting areas for anadromous fish including Chinook salmon.
  - Improve waterfowl and shorebird habitat.
  - Provide terrestrial and aquatic habitat for other wildlife species.

- **Concept –** The project will entail breaching the Prospect Island levees to restore tidal marsh, open water habitat, and some upland/riparian habitat. Prospect Island offers a unique opportunity for restoration due to comparatively little subsidence, resulting in elevations in the island interior that are assumed suitable for supporting tidal wetlands (pending more specific data).

- **Relation to SPFC Facilities –** An Environmental Assessment/Initial Study (EA/IS) conducted by the USACE and DWR in June 2001 determined that two levees bounding Prospect Island would be breached.

Project Status: Conceptual

Applicable Management Action(s): Floodplain Management – Easements/Acquisitions

Contribution to CVFPP Goals

- **Primary Goal –** Improve Flood Risk Management

- **Supporting Goals –** Promote Ecosystem Functions, Improve O&M, Promote Multi-Benefit Projects

Extent of Benefit Area: Regional: flooding and ecological benefits in the local area.

Potential to Provide Multi-Benefits:

- **Flood Damage Reduction Benefit –** In the past, levees damaged by floods have had to be repaired. Breaching the levees in a way that will keep shipping lanes safe, will eliminate future need for repairs.

- **Ecosystem Restoration –** The following opportunities have been identified:

  - Between 500 and 1000 acres of intertidal freshwater marsh will be created, depending on the actual elevations of the island.

  - Will partially satisfy required actions and Reasonable and Prudent Alternatives (RPA) in the Salmon Operations Criteria and Plan (OCAP) Biological Opinion (Action 1.6.2 (Liberty Island/Lower Cache Slough)) and the Delta Smelt OCAP Biological Opinion – RPA 4 (restore 8,000 acres of tidal marsh)

- Identified as a Potential Action in the Fish Restoration Program Agreement between DFG and DWR
- Identified as a Bay-Delta Conservation Plan (BDCP) Priority Project for Near-Term Implementation and will count towards the BDCP aquatic habitat target acreage
- Several special-status wildlife species could benefit from the creation of wetland, open water, and riparian habitats in the expanded floodplain. Species include the delta smelt, Sacramento splittail, Central Valley steelhead, and Chinook salmon.

- **Water Supply –** Wetlands are known to improve water quality by binding sediment and removing nitrogen. Improved water quality could have positive impacts on regional water supplies.

- **Recreation and Other Benefits –** Recreational fishing and waterfowl hunting as well as ecotourism could be enhanced by the creation of a wetlands area.

  Fishery production has been measured in the Delta for at least the past 30 years and has been in decline. This decline was accompanied by a loss of perennial shallow-water habitat (SWH). It is hypothesized that the loss of perennial SWH contributed to the decline in food web resources in the Delta, because wetlands are sources of organic matter and nutrients needed for production at the base of the food web and nursery habitat for juvenile fish.

Implementation Cost: Estimated total cost for interim management, planning, and construction is between $15 million and $20 million.

Implementation Considerations:

- **Redirected Hydraulic Impacts –** Flood protection is provided by removing the existing structures and allowing the natural flooding to occur in the project area. This should not negatively impact flooding in surrounding areas.

- **Adverse Environmental Impact and Regulatory Issues –** Temporary construction impacts to wildlife, caused by habitat disturbance and noise, would be offset by long-term improvements in habitat values.

Associated Studies

Prospect Island is adjacent to planned and existing restoration projects in the Cache Slough Complex area. Restoration actions are already underway at nearby Liberty Island.

Prospect Island Environmental Monitoring Plan. Available: <http://www.water.ca.gov/iep/activities/monitor/pi_monitor/MonitorPlan.cfm>

References

Delta Habitat Projects news release. Available: <http://www.water.ca.gov/news/newsreleases/2010/122210delta_habitat_projects.pdf>

California Department of Water Resources (DWR). Prospect Island Restoration Project Presentation. Available: <http://www.deltacouncil.ca.gov/delta_council_meetings/11_2010/docs/supplemental_meeting_materials/DWR_Prospect_Island_Restoration_Project_Presentation.pdf>

Prospect Island Ecosystem Restoration Project EA/IS. Available: <http://deltarevision.com/2001_docs/2001prospect_island.pdf>

1.24 Acquisition and Complete Restoration of Liberty Island

Project Type: Floodplain Management

Location Information:

- **Region** – Delta
- **Subregion** – Not applicable
- **Location** – Located in the north delta in the Cache Slough Complex, at the southern end of the Yolo Bypass
- **Community Setting** – Nonurban area

Project Proponents:

- **Potential Lead Non-Federal Agency** –DWR
- **Potential Lead Federal Agency** – UFWS
- **Potential Partners** –DFG, CALFED, NMFS, Private corporations, Nonprofit environmental organizations
- **Contact Information**

Description:

- **Purpose** – Liberty Island already supports significant existing wildlife and has outstanding potential for restoration, floodplain management, and endangered species recovery.
- **Concept** – Liberty Island is an inundated island encompassing 5,209 acres in the northern Sacramento-San Joaquin Delta (Delta). It has been flooded since 1998 when levees were breached during high-water flows and the levees were not repaired by the landowners. Future restoration plans for Liberty Island are envisioned to use passive approaches that would allow wetland and riparian vegetation to establish naturally. Restoration may also include:
  - Creating additional breaches in the levee filling agricultural water delivery and drainage ditches,
  - Leveling an existing road bisecting the property

- Excavating meandering sloughs to improve habitat quality and native fish access and to prevent fish stranding.

- **Relation to SPFC Facilities –** Additional breaches may be made to the levee.

Project Status: Unclear. Restoration activities have already taken part on a small portion (186 acres) by Wildlands Inc. to create the Liberty Island Conservation Bank at the northern tip of Liberty Island; however, this does not appear to be a part of this project.

Applicable Management Action(s): Floodplain Management – Easements/Acquisitions

Contribution to CVFPP Goals:

- **Primary Goal –** Improve Flood Risk Management

- **Supporting Goals –** Improve O&M, Promote Ecosystem Functions, Promote Multi-Benefit Projects

Extent of Benefit Area: Regional: flooding and ecological benefits in the local area.

Potential to Provide Multi-Benefits:

- **Flood Damage Reduction Benefit –** In the past levees damaged by floods have had to be repaired. Breaching the levees in a way that will keep shipping lanes safe, will eliminate future need for repairs.

- **Ecosystem Restoration –** Several special-status wildlife species could benefit from the creation of wetland, open water, and riparian habitats in the expanded floodplain. Species include the delta smelt, Sacramento splittail, Central Valley steelhead, and Chinook salmon.

- **Water Supply –** Wetlands are known to improve water quality by binding sediment and removing nitrogen. Improved water quality could have positive impacts on regional water supplies.

- **Recreation and Other Benefits –** Recreational fishing and waterfowl hunting as well as ecotourism could be enhanced by the creation of a wetlands area.

  Fishery production has been measured in the Delta for at least the past 30 years and has been in decline. This decline was accompanied by a loss of perennial SWH. It is hypothesized that the loss of perennial

SWH contributed to the decline in food web resources in the Delta, because wetlands are sources of organic matter and nutrients needed for production at the base of the food web and nursery habitat for juvenile fish.

Implementation Cost: To Be Determined

Implementation Considerations:

- **Redirected Hydraulic Impacts** – Flood protection is provided by removing the existing structures and allowing the natural flooding to occur in the project area. This should not negatively impact flooding in surrounding areas.

- **Adverse Environmental Impact and Regulatory Issues** – Temporary construction impacts to wildlife, caused by habitat disturbance and noise, would be offset by long-term improvements in habitat values.

- **Other**

Associated Studies

Liberty Island Conservation Bank Initial Study/Mitigated Negative Declaration. Available: <http://www.yolobypass.net/docs/meeting_8/liberty_island_april_09_with_tabloid_figures.pdf>

Liberty Island Environmental Monitoring Plan. Available: <http://www.water.ca.gov/iep/activities/monitor/pi_monitor/liberty/LI_Monitoring_Plan.cfm>

References

Liberty Island Conservation Bank Initial Study/Mitigated Negative Declaration. Available: <http://www.yolobypass.net/docs/meeting_8/liberty_island_april_09_with_tabloid_figures.pdf>

Delta Habitat Projects news release. Available: <http://www.water.ca.gov/news/newsreleases/2010/122210delta_habitat_projects.pdf>

1.25 Silt/Sand Bar Removal Along Lower San Joaquin River

Project Type: Operations and Maintenance

Location Information:

- **Region** – Lower San Joaquin
- **Subregion** – Not applicable
- **Location** – Lower San Joaquin (including above, within, and below Paradise Cut)
- **Community Setting** – Nonurban

Project Proponents:

- **Potential Lead Non-Federal Agency** – To Be Determined
- **Potential Lead Federal Agency** – To Be Determined
- **Potential Partners** – To Be Determined
- **Contact Information** – To Be Determined

Description:

- **Purpose** – The Flood Conveyance Plan identifies areas that need dredging throughout the lower San Joaquin River (including above, within, and below Paradise Cut)
- **Concept** – To Be Determined
- **Relation to SPFC Facilities** – None

Project Status: Unknown

Applicable Management Action(s): O&M – Dredging and Clearing

Contribution to CVFPP Goals:

- **Primary Goal** – Improve Flood Risk Management
- **Supporting Goals** – Improve O&M, Promote Ecosystem Functions, Promote Multi-Benefit Projects

Extent of Benefit Area: Project has local, regional, and systemwide benefits.

Potential to Provide Multi-Benefits:

- **Flood Damage Reduction Benefit –** Reduce physical flow constrictions from silt and sandbar issues in the San Joaquin River.

- **Ecosystem Restoration –** Silt and sand deposits results in a decrease in abundance of invertebrates that are important as fish foods, but also results in a change in invertebrate species from those inhabiting the interstitial spaces of large particles to small, burrowing forms less available to fish. DFG observed that "many [fish] have rubbed themselves raw going over the shallow sandbars." Removal of these deposits will allow for restoration of fish and other aquatic species in affected areas.

- **Water Supply –** None

- **Recreation and Other Benefits –** None

Implementation Cost: To Be Determined.

Implementation Considerations:

- **Redirected Hydraulic Impacts –** Clearing the San Joaquin River from silt and sandbar buildup would remove flow restrictions therefore allowing water to flow more freely and would alter the hydraulics of the river. No adverse hydraulics impacts expected.

- **Adverse Environmental Impact and Regulatory Issues –** Removal of silt and sandbar may disrupt riverine habitat temporarily but will improve the overall ecosystem.

- **Other**

Associated Studies

To Be Determined

References

San Joaquin River Restoration Program, Fisheries Management Plan Draft. June 2009.

1.26 Vegetation Removal Along Mokelumne River

Project Type: Operations and Maintenance

Location Information:

- **Region –** Lower San Joaquin
- **Subregion –** San Joaquin County
- **Location –** Lower San Joaquin River
- **Community Setting –** Nonurban

Project Proponents:

- **Potential Lead Non-Federal Agency –** To Be Determined
- **Potential Lead Federal Agency –** To Be Determined
- **Potential Partners –** To Be Determined
- **Contact Information –** To Be Determined

Description:

- **Purpose –** General vegetation issues exist on the Mokelumne River. Levees are typically devoid of trees and bushes, as vegetation is generally considered detrimental to the operation of the levees because it prevents easy visual inspection and because tree roots extending into the channel produce eddies that speed erosion of unreinforced soils.

  Traditional approaches to levee management involve removal of vegetation to inspect the levees. Unfortunately, this practice creates ideal habitat for ground squirrels, which prefer disturbed soils, barren ground, and elevated areas. Restoration of native riparian vegetation may be an effective means to reduce the impact of burrowing ground squirrels.

- **Concept –** Remove vegetation along the Mokelumne River.

  Legislative Platform is to urge the Legislature to adopt a State Join Resolution supporting additional language into the new Federal Water Resources Development Act, such as "Require the U.S. Army Corps of Engineers to revisit its levee vegetation removal policy to more fully evaluate the potential impacts and implementation challenges."

Information on the concept for the vegetation removal and bank stabilization in the Coral Hall Road area is currently unavailable.

- **Relation to SPFC Facilities –** Levees along the Mokelumne River in lower San Joaquin River area.

Project Status: Conceptual Level

Applicable Management Action(s): O&M – Vegetation Management

Contribution to CVFPP Goals:

- **Primary Goal –** Improve Flood Risk Management
- **Supporting Goals** – Improve O&M

Extent of Benefit Area: The project would likely local and regional benefits.

Potential to Provide Multi-Benefits:

- **Flood Damage Reduction Benefit** – The current urban flood protection system generally provides a 100-year level of flood protection. Many levees in San Joaquin County are USACE project levees; therefore, any improvements to those levees must be coordinated through the USACE. Senate Bill (SB) 5 mandates, among other things, a 200-year level of urban flood protection by 2025. The USACE administers the Lower San Joaquin River Feasibility Study to identify options for improved flood protection for existing urban areas.
- **Ecosystem Restoration –** None
- **Water Supply –** None
- **Recreation and Other Benefits –** None

Implementation Cost: $14.9 million for the Lower San Joaquin River Feasibility Study Project Cost. Project totals are unclear.

Implementation Considerations:

- **Redirected Hydraulic Impacts** – Removal of vegetation could alter the hydraulics of the banks and levees such as flow velocities.
- **Adverse Environmental Impact and Regulatory Issues –** Removal of vegetation on and near levees would have an adverse environmental

impact as the vegetation provides an important habitat to listed, threatened and endangered species.

The removal of vegetation along watercourses reduces the quantity of suitable fish habitat and can cause an increase in water temperature which may lead to fish mortality. Maintaining shoreline and aquatic vegetation provides cover for protection from predators and serves as a food source. Mokelumne River contains some of the largest concentrations of riparian habitats of the Sacramento-San Joaquin Delta; these areas are important to many wildlife species for the food, shelter, and breeding sites they provide.

- **Other**

Associated Studies

None

References

San Joaquin County. Adopted 2011 and 2012 State Legislative/Regulatory Platform and Policy Guidelines. February 8, 2011.

U.S. Fish and Wildlife Service (USFWS). The Ecology of the Sacramento-San Joaquin Delta: A Community Profile. Biological Report 85 (7.22). September 1989. Available: <http://www.nwrc.usgs.gov/techrpt/85-7-22.pdf>. Accessed: May 3, 2011

San Joaquin County. County Wide General Plan, Volume III Vegetation, Fish, and Wildlife Habitat. 1992. Available: http://www.sjgov.org/commdev/cgi-bin/cdyn.exe/handouts-planning_GP-V3-IV-F?grp=handouts-planning&obj=GP-V3-IV-F>. Accessed: May 3, 2011

1.27 Vegetation Removal and Bank Stabilization in the Coral Hall Road Area

Project Type: Operations and Maintenance

Location Information:

- **Region** – Lower San Joaquin
- **Subregion** – San Joaquin County
- **Location** – Lower San Joaquin River
- **Community Setting** – Nonurban

Project Proponents:

- **Potential Lead Non-Federal Agency** – San Joaquin County and San Joaquin Area Flood Control Agency
- **Potential Lead Federal Agency** – USACE
- **Potential Partners** – DWR, Board
- **Contact Information** – Thomas M. Gau, County of San Joaquin Public Works – Interim Director

Description:

- **Purpose** – San Joaquin Central Valley levee system that protects invaluable infrastructure has been neglected for decades. In the Coral Hall Road area, vegetation and bank stabilization are both major issues – due to environmental conflicts, San Joaquin County has been unable to remove vegetation or stabilize levee slopes.

  USACE Levee Vegetation Removal Policy – After Hurricane Katrina, the USACE made major levee policy changes, which included new standards banning vegetation on or within 15 feet or levees (2009). Levee owners and operators are concerned that the new policy does not adequately consider that levee vegetation is viewed by many resource agencies as providing important habitat to listed, threatened and endangered species. Pursuant to the Endangered Species Act (ESA), it may be impossible for many levee owners and operators to comply with the new policy within the required timeline. In addition, there is unresolved debate as to whether vegetation impairs levees, or whether some vegetation can actually help stabilize levees. San Joaquin County is urging that implementation of the levee removal policy be postponed until the impacts can be fully evaluated, and the policy is scientifically validated and properly vetted.

- **Concept –** Legislative Platform is to urge the Legislature to adopt a State Joint Resolution supporting additional language into the new Federal Water Resources Development Act, such as "Require the U.S. Army Corps of Engineers to revisit its levee vegetation removal policy to more fully evaluate the potential impacts and implementation challenges."

  Information on the concept for the vegetation removal and bank stabilization in the Coral Hall Road area is currently unavailable.

- **Relation to SPFC Facilities –** Levees along the San Joaquin River in San Joaquin County.

Project Status: Conceptual Level

Applicable Management Action(s): O&M – Vegetation Management

Contribution to CVFPP Goals:

- **Primary Goal –** Improve Flood Risk Management

- **Supporting Goals –** Improve O&M, Improve Institutional Support

Extent of Benefit Area: The project would likely local, regional, and systemwide benefits.

Potential to Provide Multi-Benefits:

- **Flood Damage Reduction Benefit –** The current urban flood protection system generally provides a 100-year level of flood protection. Many levees in San Joaquin County are USACE project levees; therefore, any improvements to those levees must be coordinated through the USACE. SB 5 mandates, among other things, a 200-year level of urban flood protection by 2025. The USACE administers the Lower San Joaquin River Feasibility Study to identify options for improved flood protection for existing urban areas.

- **Ecosystem Restoration –** None

- **Water Supply –** None

- **Recreation and Other Benefits –** None

Implementation Cost: $14.9 million for the Lower San Joaquin River Feasibility Study (LWJRFS) project cost.

Implementation Considerations:

- **Redirected Hydraulic Impacts –** Removal of vegetation could alter the hydraulics of the banks and levees such as flow velocities.

- **Adverse Environmental Impact and Regulatory Issues –** Removal of vegetation on and near levees would have an adverse environmental impact as the vegetation provides an important habitat to listed, threatened and endangered species.

- Other

Associated Studies

None

References

San Joaquin County. Adopted 2011 and 2012 State Legislative/Regulatory Platform and Policy Guidelines. February 8, 2011.

1.28 Reduce Flow Constrictions Along Ash Slough and Berenda Slough

Project Type: Operations and Maintenance

Location Information:

- **Region** – Upper San Joaquin
- **Subregion** – Madera County
- **Location** – Ash Slough and Berenda Slough
- **Community Setting** – Nonurban

Project Proponents:

- **Potential Lead Non-Federal Agency** – To Be Determined
- **Potential Lead Federal Agency** – USACE
- **Potential Partners** – Madera County Flood Control, Chowchilla Water District, DWR
- **Contact Information** – To Be Determined

Description:

- **Purpose** – The Ash Slough provides flood control to upstream dams and in some portions carries irrigation water during the irrigation season. Berenda Slough is also an overflow flood control channel that is dry most of the year and carries water during heavy rain years; Berenda Slough is not part of the irrigation system. Flooding has occurred over the Berenda Slough onto roads and farmland.
- **Concept** – To Be Determined
- **Relation to SPFC Facilities** – Ash Slough, Berenda Slough

Project Status: Unknown

Applicable Management Action(s): O&M – Reduce Flow Constrictions

Contribution to CVFPP Goals:

- **Primary Goal** – Improve Flood Risk Management

- **Supporting Goals –** Improve O&M, Improve Institutional Support, Promote Multi-Benefit Projects

Extent of Benefit Area: Project would likely have local and regional benefits.

Potential to Provide Multi-Benefits:

- **Flood Damage Reduction Benefit –** Reduce potential damage to nearby farmland, residential homes, and infrastructure.
- **Ecosystem Restoration –** Riparian habitat exists in Ash Slough.
- **Water Supply –** Groundwater is replenished at Ash Slough for irrigation water use.
- **Recreation and Other Benefits –** Open space trail system along Ash Slough and Berenda Slough that connects the urban area and Berenda Reservoir.

Implementation Cost: To Be Determined

Implementation Considerations:

- **Redirected Hydraulic Impacts –** Removing or improving restriction areas is worthwhile, but wholesale capacity increases lead to high velocities and erosion concerns.
- **Adverse Environmental Impact and Regulatory Issues –** Flood management actions, especially structural management actions, have the potential to adversely impact the environment while meeting other flood management goals. The potential impacts of this project have not yet been determined.
- **Other –** There could be compatibility or a constraint since San Joaquin River Restoration Program (SJRRP) goal could compete, or be compatible, with flood protection.

Associated Studies

To Be Determined

References

City of Chowchilla. General Plan Update 2040 Draft Environmental Impact Report. 2010.

1.29 Repair/Modify Los Banos Creek Culverts

Project Type: Operations and Maintenance

Location Information:

- **Region –** Upper San Joaquin
- **Subregion –** Los Banos Creek
- **Location –** Los Banos Creek
- **Community Setting –** Nonurban

Project Proponents:

- **Potential Lead Non-Federal Agency –** DWR
- **Potential Lead Federal Agency –** To Be Determined
- **Potential Partners –** Reclamation
- **Contact Information –** To Be Determined

Description:

- **Purpose –** There are two culverts on Los Banos Creek that constricted flow during the 1998 flood season. Reclamation and DWR's Division of Safety of Dams have completed numerous inspects of the Los Banos Detention Dam and have classified it as high risk. The water is designed to flow away from the dam, following its natural channel. Over time, cattails and tules have grown around this lower basin and the discharge path, preventing proper drainage and causing water to back up into the surrounding area. There is heavy growth of vegetation, and accumulation of debris and sediment which causes improper drainage.

- **Concept –** San Luis Creek, Los Banos Creek, and the Chowchilla River have caused flooding in the past but were not studied because reservoirs constructed in 1966. 1965, and 1975, respectively have reduced the 1 percent annual chance (100-year) discharges to less than the channel capacities. All of these streams have relatively small, leveed channels. There is no planned development along these channels.

There is a program "Vegetation and Sediment Maintenance Program at Los Banos Detention Dam" that addresses the drainage issues in the project area. Along with vegetation and sediment maintenance, the proposed actions entails stabilizing drainage slopes to prevent erosion into the creek, covering any stockpiled soil to prevent dust and siltation into the creek, and using drip pans or absorbent material to catch drips from equipment while parked.

- **Relation to SPFC Facilities –** San Luis Canal, Los Banos Detention Dam, Los Banles Creek culverts

Project Status: Conceptual Level for repair/modification of culverts; environmental documentation of maintenance program.

Applicable Management Action(s): O&M – Reduce Flow Constrictions

Contribution to CVFPP Goals:

- **Primary Goal –** Improve Flood Risk Management
- **Supporting Goals –** Improve O&M, Promote Multi-Benefit Projects

Extent of Benefit Area: Project would have local and regional benefits.

Potential to Provide Multi-Benefits:

- **Flood Damage Reduction Benefit –** Repair of the culverts will allow proper drainage and prevent water backup onto roads and damaging other infrastructure and areas upstream from the culvert. Clearing the blockage of the culvert could prevent structural hazard of the San Luis Canal and the I-5 freeway.
- **Ecosystem Restoration –** Extend area for channel restoration for birds and other wildlife.
- **Water Supply –** None
- **Recreation and Other Benefits –** None

Implementation Cost: To Be Determined

Implementation Considerations:

- **Redirected Hydraulic Impacts –** Proposed action does not alter existing drainage pattern nor result in substantial increase in the rate or amount of surface runoff in a manner in which would result in flooding on or off site.

- **Adverse Environmental Impact and Regulatory Issues –** No destruction or adverse modification of the critical habitat of endangered species. Low probability of affecting migratory birds and conservation measures have been incorporated into the project.

- **Other**

Associated Studies

None

References

U.S. Department of the Interior, Bureau of Reclamation – Mid-Pacific Region, Draft Environmental Assessment, Vegetation and Sediment Maintenance Program at Los Banos Detention Dam. June 2010.

Federal Emergency Management Agency. Flood Insurance Study. Merced County, California and Incorporated Areas. September 2010.

1.30 Mendota Pool Bypass

Project Type: Ecosystem Functions

Location Information:

- **Region –** Upper San Joaquin
- **Subregion –** Not applicable
- **Location –** Western Fresno and Madera counties
- **Community Setting –** Nonurban

Project Proponents:

- **Potential Lead Non-Federal Agency –** DWR, Reclamation
- **Potential Lead Federal Agency –** To Be Determined
- **Potential Partners –** To Be Determined
- **Contact Information –** To Be Determined

Description:

- **Purpose –** The proposed Mendota Pool Bypass would include a bypass around the Mendota Pool to convey restoration flows of at least 4,500 cfs around the Mendota Pool and reconnect with the San Joaquin River downstream from Mendota Dam. The project could also include constructing a bifurcation structure at the upper end of the bypass to convey flows into the Mendota Pool Bypass.

- **Concept –** The project includes construction, and O&M of the Mendota Pool Bypass and improvements, including O&M of the San Joaquin River channel to allow Reach 2B to convey at least 4,500 cfs. The proposed Mendota Bypass Bifurcation Structure would be designed to divert water from the San Joaquin River to the Mendota Pool, consistent with the design channel capacity of Reach 2B that conveys flows to the Mendota Pool. The bifurcation structure would be designed to direct fish into the bypass channel and minimize or avoid fish passage into the Mendota Pool. Specific bypass alignments and facilities locations will be determined through the course of the EIS/EIR study. Modifications to the current system that may be required include modifying existing levees, building new levees and a new river channel, and relocating existing infrastructure.

- **Relation to SPFC Facilities –** To Be Determined

Project Status: Feasibility Study

Applicable Management Action(s): System Modifications – Levees/Floodwalls/Hydraulic Structures

Contribution to CVFPP Goals:

- **Primary Goal –** Improve Flood Risk Management
- **Supporting Goals –** Promote Ecosystem Functions

Extent of Benefit Area: Local and regional benefits.

Potential to Provide Multi-Benefits:

- **Flood Damage Reduction Benefit** - To Be Determined
- **Ecosystem Restoration –** The project is the result of a settlement agreement that had two parallel goals. One of these goals is to restore and maintain fish populations in "good condition" in the main-stem of the San Joaquin River below Friant Dam to the confluence of the Merced River, including naturally reproducing and self-sustaining populations of salmon and other fish.

  The bifurcation structure would be designed to direct fish into the bypass channel and minimize or avoid fish passage into the Mendota Pool. The bypass channel would mitigate a problem migrating salmon would face in arriving in Mendota Pool and finding unfamiliar water of Delta origin rather than Sierra water from the San Joaquin River and a myriad of pumping and diversion structures.
- **Water Supply –** The project is the result of a settlement agreement that had two parallel goals. One of these goals is to reduce or avoid adverse water supply impacts to all of the Friant Division long-term contractors that may result from the interim flows and restoration flows provided for in the settlement.
- **Recreation and Other Benefits**

Implementation Cost: To Be Determined

Implementation Considerations:

- **Redirected Hydraulic Impacts –** Restoration actions, including the Mendota Pool Bypass have the potential to conflict with the routing of Kings River flood flows. The Mendota Pool Bypass would cause substantial changes to the geomorphology of the river. These changes could alter sediment transport and river hydraulics, potentially changing erosion and sedimentation characteristics, changing flow routing and 'stress' points on adjacent levees and other infrastructure, and changing overall flooding characteristics. The bypass could also cause increased seepage in the area, exacerbating already high groundwater levels around the Mendota Pool. Long-term impacts to agricultural lands are expected as a result of high groundwater levels that are likely to affect production on adjacent agricultural lands. Substantial flood easements, mitigation, or acquisition of these lands will be necessary.

  Construction of the new bifurcation structure may cause changes in localized river hydraulics and flood flow characteristics causing excessive sand deposition in the area, necessitating additional sand removal (dredging) activities.

- **Adverse Environmental Impact and Regulatory Issues –** Flood management actions, especially structural management actions, have the potential to adversely impact the environment while meeting other flood management goals. The potential impacts of this project have not yet been determined.

Associated Studies

To Be Determined

References

Mendota Pool Bypass and Reach 2B Improvements Public Scoping Report. February 2010. Available: <http://www.restoresjr.net/program_library/02-Program_Docs/Reach2BScopingReportMainDoc201002.pdf>

USBR Federal Register Notice to Prepare an EIR/EIS. July 2009. Available: <http://www.federalregister.gov/articles/2009/07/13/E9-16462/mendota-pool-bypass-and-reach-2b-improvements-project-under-the-san-joaquin-river-restoration#p-15>

1.31 Consider Structural Modifications to Mariposa Bypass

Project Type: System Modifications

Location Information:

- **Region** – Upper San Joaquin
- **Subregion –** Not applicable
- **Location –** San Joaquin River from the Reach 4B headgates near Washington Road to the confluence of the Mariposa Bypass with the San Joaquin River
- **Community Setting –** Nonurban

Project Proponents:

- **Potential Lead Non-Federal Agency** – DWR, Reclamation
- **Potential Lead Federal Agency –** To Be Determined
- **Potential Partners** – To Be Determined
- **Contact Information –** To Be Determined

Description:

- **Purpose** – Part of the proposed Reach 4B, Eastside Bypass, and Mariposa Bypass Channel and Structural Improvements Project under the SJRRP.
- **Concept –** The proposed action includes improving conveyance capacity in the San Joaquin River from the Reach 4B headgates near Washington Road to the confluence of the Mariposa Bypass with the San Joaquin River (generally referred to as Reach 4B1). The improvements will incorporate modifications to Reach 4B and the Eastside and Mariposa bypass channels to allow for conveyance of Interim and Restoration flows to allow for fish passage. Improvements will also include the incorporation of fish habitat in Reach 4B and/or the bypasses and maintain the current flood operations and conveyance capacity of the system. Additionally, the proposed action may result in an opportunity for improvements to the existing flood system.

Project aspects include:

- Channel modifications to Reach 4B to ensure conveyance of at least 475 cfs.

- Modifications to the San Joaquin River headgates at the upstream end of Reach 4B to ensure fish passage and enable flow routing into Reach 4B.

- Modifications to the Sand Slough Control Structure to ensure fish passage.

- Modifications to structures in the Eastside and Mariposa bypass channels to provide anadromous fish passage on an interim basis until a final flow routing is selected and completed.

- Modifications in the Eastside and Mariposa bypass channels to establish a suitable low-flow channel, if the Secretary in consultation with the Restoration Administrator (RA), determines that such modifications are necessary to support anadromous fish migration through these channels.

* **Relation to SPFC Facilities –** To Be Determined

Project Status: Feasibility study

Applicable Management Action(s): System Modifications & Ecosystem Functions

Contribution to CVFPP Goals:

* **Primary Goal –** Improve Flood Risk Management

* **Supporting Goals –** Promote Ecosystem Functions

Extent of Benefit Area: Local, regional, and systemwide benefits.

Potential to Provide Multi-Benefits:

* **Flood Damage Reduction Benefit** – The San Joaquin River Stipulation of Settlement (Settlement) stipulates that channel modifications be made in Reach 4B to ensure conveyance of at least 475 cfs. Based on preliminary information, these modifications may consist of removing in-channel vegetation, removing excess silt and sediment, and improving road crossings, and may or may not necessitate modifying the existing levee system. Modifications to the

San Joaquin River headgate and the Sand Slough Control Structure could include modifications to the existing structures or replacement of the existing structures with new structures. Improvements to the channel could reduce flood impacts locally.

- **Ecosystem Restoration –** The Settlement stipulates modifications to structures in the Eastside and Mariposa bypasses to provide for fish passage and modifications to the Eastside and Mariposa bypasses to establish a low flow channel. Both the Mariposa Bypass Bifurcation Structure at the head of the Mariposa Bypass and the Mariposa Bypass Drop Structure at the downstream end of the Mariposa Bypass may need to be modified to provide for fish passage under a range of flows (both low and high flows). Modifications could include modifications to the existing structures, construction of fish ladders, or replacement of the existing structures with new structures. In addition, modifications to the low-flow channel may be needed to allow for fish passage under low flows in the Eastside and Mariposa bypasses.

- **Water Supply –** San Joaquin Settlement stipulates that the project should reduce or avoid adverse water supply impacts to all of the Friant Division long-term contractors that may result from the interim flows and restoration flows provided for in the settlement.

- **Recreation and Other Benefits**

Implementation Cost: To Be Determined

Implementation Considerations:

- **Redirected Hydraulic Impacts –** Existing channel capacity in Reach 4B is extremely limited. Flows of any amount down this reach are likely to cause localized flooding and seepage impacts to adjacent agricultural lands.

- **Adverse Environmental Impact and Regulatory Issues –** Flood management actions, especially structural management actions, have the potential to adversely impact the environment while meeting other flood management goals. The potential impacts of this project have not yet been determined.

- **Other**

Associated Studies

To Be Determined

References

U.S. Bureau of Reclamation. Federal Register Notice to Prepare an EIR/EIS. November 2010. Available: http://www.federalregister.gov/articles/2010/11/22/2010-29330/san-joaquin-river-restoration-program-reach-4b-eastside-bypass-and-mariposa-bypass-channel-and#p-7

Reach 4B, Eastside Bypass, and Mariposa Bypass Low Flow Channel and Structural Improvements Project Improvements Public Scoping Report. January 2010. Available: http://www.restoresjr.net/activities/site_specific/R4B/R4BScopingReportPublicDraftMainDoc201001.pdf

1.32 Consider Westside Integrated Regional Water Management (IRWM) Projects

Project Type: System Modifications

Location Information:

- **Region** – Upper San Joaquin
- **Subregion** – Cache Creek and Putah Creek
- **Location** – Yolo County
- **Community Setting** – Nonurban

Project Proponents:

- **Potential Lead Non-Federal Agency** – Solano County Water Agency
- **Potential Lead Federal Agency** – To Be Determined
- **Potential Partners** – Lake County Watershed Protection District, Napa County Flood Control and Water Conservation District, Colusa County Resource Conservation District, Water Resources Association of Yolo County
- **Contact Information** – Chris Lee, Supervising Environmental Scientist, Solano County Water Agency

Description:

- **Purpose** – The Westside IRWMP represents primarily the Cache and Putah Creek watersheds. The watersheds of these two creeks encompass portions of Lake, Napa, Solano, Colusa, and Yolo counties. The IRWMP will provide a guideline for implementing watershed planning activities throughout the five-county region.
- **Concept** – The Westside IRWM includes setback levees to capture water, including West Stanislaus.
- **Relation to SPFC Facilities** – To Be Determined

Project Status: Anticipated to take 2 years to complete and adopt the IRWMP (estimated 2013)

Applicable Management Action(s): System Modifications – Setback Levees

Contribution to CVFPP Goals:

- **Primary Goal –** Improve Flood Risk Management
- **Supporting Goals –** To Be Determined

Extent of Benefit Area: Project will potentially have local, regional, and systemwide benefits.

Potential to Provide Multi-Benefits:

- **Flood Damage Reduction Benefit –** To Be Determined (Report is in progress/has not begun)
- **Ecosystem Restoration –** To Be Determined (Report is in progress/has not begun)
- **Water Supply –** To Be Determined (Report is in progress/has not begun)
- **Recreation and Other Benefits –** To Be Determined (Report is in progress/has not begun)

Implementation Cost: $1.5 million

Implementation Considerations:

- **Redirected Hydraulic Impacts –** To Be Determined (Report is in progress/has not begun)
- **Adverse Environmental Impact and Regulatory Issues –** To Be Determined (Report is in progress/has not begun)
- **Other**

Associated Studies

Westside IRWM Plan is in progress

References

Solano County Water Agency. Request for Statement of Qualifications for Development of an Integrated Regional Water Management Plan for the Westside Subregion of the Proposition 84 Sacramento River Funding Area. December 13, 2010. Available: <http://www.scwa2.com/Documents/IRWMP/A-112B.Revised.Westside.RFQ.pdf>

California Department of Water Resources. Integrated Regional Water Management Grants Website. Available: <http://www.water.ca.gov/irwm/integregio_planning.cfm>

Yolo Water Resources Agency. Minutes of Executive Committee Meeting, March 1, 2011. Available: < http://www.yolowra.org/executive_agendas/2011/Minutes%20EC%2003-01-11.pdf>

1.33 Pioneer Site Seepage Berm

Project Type: System Modifications

Location Information:

- **Region –** Lower Sacramento
- **Subregion** – Sacramento
- **Location –** Pioneer Reservoir project located adjacent to the Sacramento River in the City of Sacramento; just upstream from the Pioneer Bridge that U.S. Highway 50 uses to cross the Sacramento River. The project runs in a north-south direction and is bounded on the north by Capitol Mall, on the south by U.S. Highway 50, on the east by Pioneer Reservoir, and on the west by the Sacramento River
- **Community Setting** – Urban

Project Proponents:

- **Potential Lead Non-Federal Agency –** To Be Determined
- **Potential Lead Federal Agency** – USACE
- **Potential Partners** – Reclamation, State of California, SAFCA
- **Contact Information** – Annalena Bronson (Reclamation)

Description:

- **Purpose** – Based on recent data from the USACE, SAFCA has identified the Natomas Basin as being at a particularly acute risk of flooding. There has been an increased understanding of underseepage and through seepage problems that jeopardize levee stability when investigating for the Common Features project. The Common Features is developed to provide flood risk management to the City of Sacramento, including Natomas Basin and areas along the north and south sides of the American River. Expanding urban centers lie in floodplains where flooding could result in extensive loss of life and billions of dollars in damages
- **Concept** – The project involves the construction of a seepage berm approximately 500 feet long and 50 feet wide along the landslide of the Sacramento River east-bank levee at RM 58.5; and the installation of

five relief wells adjacent to the seepage berm (north and south end of berm). The berm would be constructed with drain rock and water from the berm and the wells would be discharged into the adjacent City of Sacramento wastewater system where it would be treated.

SAFCA has adopted a goal of providing 100-year flood protection to the project area by the year 2010.

- **Relation to SPFC Facilities –** Levees along the Sacramento River and American River

Project Status: Planned

Applicable Management Action(s): System Modifications – Levees/Floodwalls/Hydraulic Structures

Contribution to CVFPP Goals:

- **Primary Goal –** Improve Flood Risk Management
- **Supporting Goals –** Improve O&M, Promote Ecosystem Functions

Extent of Benefit Area: This project would have local and regional benefits.

Potential to Provide Multi-Benefits:

- **Flood Damage Reduction Benefit –** The levees in the Natomas Basin protect approximately 53,000 acres of improved agriculture, conservation, and urban lands. Lands owned by the Sacramento International Airport account for more than 10 percent of the total. An uncontrolled flood in the Natomas Basin would cause substantial direct damage to structures in the basin, estimated at $7.4 billion, and could pose a serious threat of injury and loss of life.
- **Ecosystem Restoration –** Existing vegetation will be preserved to the maximum degree possible, consistent with emerging new USACE levee vegetation guidelines, so as to retain most of the existing riparian habitat values.
- **Water Supply**
- **Recreation and Other Benefits**

Implementation Cost: To Be Determined

Implementation Considerations:

- **Redirected Hydraulic Impacts –** To Be Determined
- **Adverse Environmental Impact and Regulatory Issues –** Flood management actions, especially structural management actions, have the potential to adversely impact the environment while meeting other flood management goals. The potential impacts of this project have not yet been determined.
- **Other**

Associated Studies

To Be Determined

References

State of California Website. Available: <http://www.ceqanet.ca.gov/DocDescription.asp?DocPK=595433>. Accessed: May 3, 2011

U.S. Army Corps of Engineers (USACE). Revised Final Independent External Peer Review Report for the Engineering and Economic Reevaluation of the Geotechnical, Hydrological, Hydraulic, and Economic Aspects of Flood Risk Reduction report, American River Common Features. 2010. Available: <http://www.usace.army.mil/CECW/PlanningCOP/Documents/peer/natomas_comments.pdf>. Accessed: May 3, 2011

USACE. Natomas Levee Improvement Program Bank Protection Project Draft Environmental Impact Report. September 2007. Available <http://www.safca.org/documents/FullDEIR_000.pdf>. Accessed: May 3, 2011

1.34 Levee Repair of 25 Erosion Sites Sacramento River Bank Protection Project

Project Type: System Modifications

Location Information:

- **Region** – Upper and Lower Sacramento
- **Subregion** – Sacramento, Yolo, Colusa, Sutter, and Tehama counties
- **Location** – Along the Sacramento River and its tributaries in Sacramento, Yolo, Colusa, Sutter, and Tehama counties
- **Community Setting** – Urban

Project Proponents:

- **Potential Lead Non-Federal Agency** – DWR
- **Potential Lead Federal Agency** – USACE
- **Potential Partners** – Board
- **Contact Information** – Kip Young, Staff Environmental Scientist; Mike Dietl, USACE

Description:

- **Purpose** – The Sacramento River Bank Protection Project (SRBPP) is a continuing construction project authorized by Section 203 of the Flood Control Act of 1960. The purpose of this project is to provide protection to the Sacramento River Flood Control Project (SRFCP).

  Beginning in the 1840s, low, discontinuous levees were built by individual landowners. Since that time, a variety of levee improvement projects have been implemented to regulate and repair the system. Higher winter flows can erode and stress the levees, weakening them and causing them to fail in certain locations. To maintain the integrity of the flood control system, locations within the potential for failure are identified and remedied under the SRBPP.

  Based on field assessments of the SRBPP levees conducted in 2007, the Board and the USACE have identified priority sites that are at risk of erosional failure during flooding and/or normal flow conditions. These sites must be repaired before their condition becomes so critical as to require emergency repair.

- **Concept –** Proposed action consists of implementing bank protection measures along 15,646 linear feet of levees along the Sacramento River and tributaries during 2009 and 2010. Bank protection measures at 22 of the erosion sites would include (1) reinforcing the bank toe with riprap, (2) placing a mixture of riprap and soil on upper banks and tops of the lower bank riprap to create riparian benches above the mean summer water elevation, and (3) planting the benches and upper banks with vegetation to provide bank stabilization and riparian habitat. In-stream woody material (IWM) would also be placed along the sites to provide bank protection and aquatic habitat. Work at the remaining three erosion sites would consist of constructing setback levees on the landside of their existing levees.

  Bank protection measures typically consist of large angular rock placed to protect the bank and then a layer of soil/rock material is placed to allow vegetation to grow back on the bank. In addition, dead trees may be added to the mixture for additional habitat use.

Project Status:

Design

Applicable Management Action(s): System Modifications – Levees/Floodwalls/Hydraulic Structures

Contribution to CVFPP Goals:

- **Primary Goal –** Improve Flood Risk Management
- **Supporting Goals –** Improve O&M, Promote Ecosystem Functions

Extent of Benefit Area: Project has local and regional benefits.

Potential to Provide Multi-Benefits:

- **Flood Damage Reduction Benefit –** The primary goal of this project is to reduce flood damage for the project area by existing levee rehabilitation.
- **Ecosystem Restoration –** Project will retain existing IWM to the greatest extent practical to maintain size, volume, and complexity. It is to incorporate restoration and increase native riparian vegetation.

- **Water Supply –** Best management practices (BMP) will be implemented to protect water quality, and aquatic habitat, from increased suspended sediments, sedimentation, and chemical pollutants during construction.

- **Recreation and Other Benefits –** Restored levees would ensure local approach visibility for recreational boaters through the use of natural indicators, such as partially emergent portions of IWM and vegetation on the low elevation areas, to act as visual warning of the present of shallowly submerged hardscape.

Implementation Cost: Typically funding ranges from $20 million to $30 million a year. Only a portion of this amount is spent within SAFCA's jurisdiction.

Implementation Considerations:

- **Redirected Hydraulic Impacts –** Placing riprap into the river channel may increase the flow velocity within the channel. No significant hydraulic impacts should be anticipated as the project is a repair of existing facilities.

- **Adverse Environmental Impact and Regulatory Issues –** This project would not substantially degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, reduce the number or restrict the range of a special-status species, or eliminate important examples of California history or prehistory. No substantial evidence exists that the project would have a negative or adverse effect on the environment.

- **Other**

Associated Studies

Draft Environmental Assessment/Initial Study for Levee Repair of 25 Erosion Sites Volume 1 Sacramento River Bank Protection Project (April 2009)

References

2009. U.S. Army Corps of Engineers and the Central Valley Flood Protection Board. DRAFT Initial Study (IS) and Proposed Mitigated Negative Declaration. The Erosion Repairs of 5 Bank

Protection Sites, 2009 and 2010. Sacramento River Bank Protection Project. April 19.

Sacramento Bank Protection Project Website. Available: <http://www.safca.org/Programs_SacBankProtection.html>. Accessed: May 2, 2011.

California Department of Water Resources. Sacramento River Bank Protection Project. Planning Activities Update. Available: <http://www.water.ca.gov/pubs/flood/sacramento_river_bank_protection_project_-_phase_iii/srbpp_-_phase_3_handout_060209.pdf.>. May 2009.

1.35 South Sacramento County Streams Project Union House Creek Channel Upgrades

Project Type: System Modifications

Location Information:

- **Region** – Lower Sacramento
- **Subregion** – Sacramento
- **Location** – Union House Creek
- **Community Setting** – Urban

Project Proponents:

- **Potential Lead Non-Federal Agency** – To Be Determined
- **Potential Lead Federal Agency** – USACE
- **Potential Partners** – Board, Sacramento Area Flood Control Agency
- **Contact Information** – Marsha Sells

Description:

- **Purpose** – The southern portion of the Sacramento urbanized area has historically been vulnerable to flooding from high-water events in the Delta as well as high flows on Morrison Creek, Florin Creek, Elder Creek, and Unionhouse Creek. The South Sacramento Streams Group Project (SSSG), which encompasses these creeks has been the vehicle to improve these creeks. The SSSG project consists of levee improvements starting south of the town of Freeport and running easterly along Morrison Creek and into the urbanized area. This levee crosses the Union Pacific Railroad (UPRR) tracks and extends up four creeks, all within the Morrison Creek watershed. Along these four creeks, a combination of raising the levee, constructing floodwall and channel improvements are being used to provide protection to the community.

  South Sacramento County Streams drainage basin has a long history of flooding during heavy rainfall. Recent flooding in 1952, 1955, 1962, 1963, 1982, and 1986 damaged residences, business, and agricultural land and disrupted transportation and public facilities. Local runoff from the Morrison Creek watershed can cause flooding due to limited channel capacities and bridge restrictions and contributes to the flood volume in the Beach-Stone Lakes area. In addition the overflow from the Cosumnes and Mokelumne rivers inundates Beach-Stones Lakes, causing high backwater on the study creeks, and threatening the Sacramento Regional Wastewater Treatment Plant and the Pocket Area.

- **Concept** – The proposed action includes reshaping the creek bed and channel into a rectangular concrete lined channel. The proposed action would raise the level of flood protection in the project area to a point that it can safely contain a flood event with less than a 1 percent chance of occurrence in any given year and ensure that the area meets the minimum FEMA level of flood protection.

- **Relation to SPFC Facilities –** None

Project Status: Construction (expected to occur in 2013)

Applicable Management Action(s): System Modifications – Levees/Floodwalls/Hydraulic Structures

Contribution to CVFPP Goals:

- **Primary Goal –** Improve Flood Risk Management

- **Supporting Goals –** Improve O&M

Extent of Benefit Area: This project would have local and regional benefits.

Potential to Provide Multi-Benefits:

- **Flood Damage Reduction Benefit –** The project aims to protect this urbanized area from damages to its residences, businesses, and agricultural lands, and protect disruptions of major transportation and public facilities such as Interstate 5 and the Sacramento Regional Wastewater Treatment Plant.

- **Ecosystem Restoration –** Creation of ponds and wetlands, selected planting and seeding, and conversion of areas to higher value wildlife habitat as part of the larger South Sacramento Streams Group Project.

- **Water Supply –** None

- **Recreation and Other Benefits –** There are no existing recreational facilities located adjacent to the Unionhouse Channel Upgrades construction, and no anticipated efforts on recreation in the project area.

Implementation Cost: Approximately $5 million to 10 million

Implementation Considerations:

- **Redirected Hydraulic Impacts –** Upon reviewing the pre-project and post-project floodplains, the reduced stages indicate that there would not be a negative upstream backwater effect due to the proposed channel upgrades. There would also be no negative downstream hydraulic effects due to the proposed channel upgrades. There is a low potential for groundwater quality and levels to be affected by the proposed action. Therefore, there would be little or no change in groundwater recharge or depletion of groundwater sources used for other beneficial uses.

- **Adverse Environmental Impact and Regulatory Issues –** Construction activities would impact approximately 7 acres of the bank of Unionhouse Creek. This area consists of disturbed habitat and will be affected by the channel improvements. The removal of vegetation on the banks will result in a decrease in cover along the edge of the channel as well as decrease in the input of organic material into the channel, which provide food for aquatic invertebrates and other aquatic species. The proposed project is not expect to have an adverse affect on special-status fish species or their habitats because (1) existing fish habitat is poor, (2) Unionhouse Creek is not designated as Essential Habitat or Critical Habitat, and (3) Unionhouse Creek does not support special-status fish except during flood events.

- **Other**

Associated Studies

South Sacramento County Streams Project – Unionhouse Creek Channel Upgrades Draft Environmental Assessment/Initial Study (October 2008)

References

U.S. Army Corps of Engineers (USACE). South Sacramento County Streams Flood Damage Reduction Project, Morrison Creek at Union Pacific Road (Contract 2A), Sacramento, CA. 2011. Available: <https://www.fbo.gov/index?s=opportunity&mode=form&id=496c

5711b26c54e56f66249d7bc43174&tab=core&tabmode=list&print_preview=1>

USACE. South Sacramento County Stream Project Unionhouse Creek Channel Upgrades, Draft Environmental Assessment/Initial Study. October 2008.

Sacramento Area Flood Control Agency Website. Available: <http://www.safca.org/Programs_SoSacStreams.html>. Accessed: May 2, 2011.

DWR Strategic Growth Plan, Bond Accountability Website. Available: http://bondaccountability.resources.ca.gov/Project.aspx?ProjectPK=3860-P1E-047&pid=5 Accessed: May 2, 2011.

1.36 Smith Canal Closure Conceptualization

Project Type: System Modifications

Location Information:

- **Region –** Lower San Joaquin
- **Subregion –** Stockton/Lodi
- **Location –** The Smith Canal is a backwater slough of the Delta in the City of Stockton, just north of the Deep Water Ship Channel. Smith Canal has a small drainage area, so its border levees primarily serve to prevent back-flooding from the Delta, rather than to confine upland riverine flows
- **Community Setting –** Urban

Project Proponents:

- **Potential Lead Non-Federal Agency –** San Joaquin Area Flood Control Agency
- **Potential Lead Federal Agency –** USACE
- **Potential Partners –** FEMA, California Department of Boating and Waterways, CFG, U.S. Coast Guard, State Lands Commission, USFWS, National Oceanic and Atmospheric Administration (NOAA) Fisheries Services
- **Contact Information –** San Joaquin Area Flood Control Agency

Description:

- **Purpose –** The Smith Canal levees are highly encroached upon, and certification to FEMA standards may require removal of a substantial number of residential structures before completing required certification investigations, analyses, and construction of required improvements. A more feasible solution will be to construct a closure structure near the mouth of the Canal to limit back-flooding from the Delta. The conceptualization of a closure structure in this project area was asked to be developed by San Joaquin Area Flood Control Agency (SJAFCA).

- **Concept –** A closure structure across the mouth of the Smith Canal has been found to be technically feasible, and can be accredited by FEMA as providing protection against the base flood. If this project can be accredited by FEMA and a decision made to further pursue this concept, the following steps would be made:
  - Prepare a Feasibility Study to analyze alternatives, calculate benefit/cost ratios, define operation procedures and responsibilities, and identify a financing plan
  - Prepare an environmental document under California Environmental Quality Act (CEQA) and National Environmental Policy Act (NEPA), and initiating permitting activities
  - Seek a Conditional Letter of Map Revision from FEMA
  - Seek grants from the State to fund construction
  - Form existing or new assessment districts to pay the local share of construction, O&M, and foreseeable replacements.
- **Relation to SPFC Facilities –** None

Project Status: Feasibility Study (Draft report scheduled completion July 2016)

Applicable Management Action(s): System Modifications – Levees/Floodwalls/Hydraulic Structures

Contribution to CVFPP Goals:

- **Primary Goal –** Improve Flood Risk Management
- **Supporting Goals** – Improve O&M

Extent of Benefit Area: This project would have local and regional benefits.

Potential to Provide Multi-Benefits:

- **Flood Damage Reduction Benefit –** This project would protect a substantial number of residential structures and infrastructure in this urban community.
- **Ecosystem Restoration –** None

- **Water Supply –** None
- **Recreation and Other Benefits –** None

Implementation Cost: Approximately $25.3 million to 30.4 million (not including annual O&M costs or a sinking fund for replacements)

Implementation Considerations:

- **Redirected Hydraulic Impacts –** Construction of facilities such as a gate control station, pump station, new levees would alter the hydraulics of the project area. The project will be designed to keep flood waters out of the project during base floods.
- **Adverse Environmental Impact and Regulatory Issues –** Any proposed facilities to this area would have an environmental impact. The project requires formal consultation with USFWS on the potential effects to federally threatened and endangered species such as delta smelt and the giant gartner snake (*Thamnophis gigas*). A CWA 404 permit is required and consultation can take place through USACE. USFWS requires a biological assessment that analyzes the direct, indirect, and cumulative effects to federally listed species from the proposed project, as well as proposed minimization measures.
- **Other**

Associated Studies

Lower San Joaquin River Feasibility Study

References

Peterson Brustad, Inc. San Joaquin Area Flood Control Agency Smith Canal Closure Structure Conceptualization. June 27, 2008.

1.37 Lower San Joaquin River Feasibility Study

Project Type: System Modifications

Location Information:

- **Region –** Lower San Joaquin
- **Subregion –** Stockton/Lodi
- **Location –** The study area is located along the lower (northern) portion of the San Joaquin River system in the Central Valley of California. The river flows west to the Central Valley, where it is joined by the Merced, Tuolumne, Stanislaus and Calaveras rivers, and other small tributaries, as it flows north to the Delta. The LSJRFS area includes the main-stem of the San Joaquin River from the Mariposa Bypass downstream to and including the city of Stockton. The study area also includes the distributary channels of the San Joaquin River in the southernmost reaches of the Delta
- **Community Setting –** Other

Project Proponents:

- **Potential Lead Non-Federal Agency –** To Be Determined
- **Potential Lead Federal Agency –** USACE
- **Potential Partners –** State Central Valley Flood Protection Board (supported by Board), San Joaquin Area Flood Control Agency
- **Contact Information –**
  - Michelle Williams, USACE
  - Michael Musto, DWR
  - Juan Neira, SJAFCA

Description:

- **Purpose –** Results of this study will help determine needed improvements for future flood protection systems in an effort to reach or exceed the future 200-year level of flood protection. Major flooding in San Joaquin, Stanislaus, and Merced counties along the San Joaquin River occurred in 1983, 1986, 1995 and 1997, causing millions of dollars of damages to homes, businesses, agricultural crops, and development. Flood damages along the San Joaquin River will likely continue to increase due to population growth and urban development.

The proposed project would increase the conveyance capacity of Paradise Cut by setting back approximately 20,000 feet of existing levee, dry excavating approximately 3,000,000 cubic yards to the San Joaquin River, increasing conveyance in the upstream portion of the San Joaquin River.

- **Concept –** A major challenge of the LSJRFS is coordinating the combining flood damage reduction and ecosystem restoration project elements with other ongoing water resources programs, such as the CALFED Bay-Delta Program, Central Valley Project Improvement Act (CVPIA), the SJRRP, the CVFPP, BDCP, and the Delta Vision.

  The primarily planning objectives within the LSJRFS area include:

  - Reduce the risk of flooding to people and property, and economic damages due to flooding within the primary study area
  - Develop a sustainable flood management system for the future, as well as a plan to address and communicate residual flood risks
  - Reduce the risk of adverse consequences of floods when they do occur
  - Restore the quantity, quality, diversity, and connectivity of riparian, wetland, floodplain, and shaded riverine aquatic habitats where appropriate.

  Concepts of the plan have not been developed. Milestones for this project are to formulate, evaluate, and compare alternatives; then identify a tentative recommended plan; followed by a selected recommended plan that will result in a record of decision.

- **Relation to SPFC Facilities –** Facilities (e.g., levees, channels, weird, control structures, pumping plants) within the project area

Project Status: Feasibility Study (Plan by 2012; Construction Completed by 2025)

Applicable Management Action(s): System Modifications – Levees/Floodwalls/Hydraulic Structures

Contribution to CVFPP Goals:

- **Primary Goal –** Improve Flood Risk Management
- **Supporting Goals –** Improve O&M, Promote Ecosystem Functions, Improve Institutional Support, Promote Multi-Benefit Projects

Extent of Benefit Area: The project will have local, regional, and/or systemwide benefits.

Potential to Provide Multi-Benefits:

- **Flood Damage Reduction Benefit –** The lower San Joaquin River area has experienced several majors floods in the last 30 years causing millions of damages to properties and businesses. The 1997 flood event damaged 1,842 residences, mobile homes, and businesses in San Joaquin and Stanislaus counties. Estimated average annual equivalent damages (Year 2000) from floods in the lower San Joaquin River Basin amount to about $20 million, based on preliminary HEC-FDA model for the Comprehensive Study. Crop damages ($9 million) account for nearly half of the estimated damages. The primary objective of this project is to reduce the risk of flooding to people and property, and economic damages due to flooding within the primary study area. The project will develop a sustainable flood management system for the future, as well as a plan to address and communicate residual flood risks.
- **Ecosystem Restoration –** The LSJRFS states "there is a significant need to include ecosystem restoration into any plan including consideration of flood damage reduction in the area." There is a major problem with the San Joaquin River ecosystem where hydraulic and geomorphic processes have been severely compromised by flow regulation and confinement of the river by levees and bank protection along portions of the channel. These changes have contributed to declining populations of many plants, fish, and wildlife species associated with these habitats. There is tremendous potential in ecosystem restoration for bird species, plant species, and the riparian habitat.
- **Water Supply –** Water supply benefits for this project are not yet known.
- **Recreation and Other Benefits –** Recreation and other benefits for this project are not yet known.

Implementation Cost: Estimated $10 million

Implementation Considerations:

- **Redirected Hydraulic Impacts –** There will be hydraulic impacts due to from this project, but the severity of the redirected impacts will not be known until the alternatives are presented.
- **Adverse Environmental Impact and Regulatory Issues –** There may be adverse environmental impacts and regulatory issues from this project.
- **Other**

Associated Studies

Lower San Joaquin River, California Feasibility Study, 2009

References

San Joaquin Area Flood Control Agency (SJAFCA). Website. Available: <http://www.sjafca.com/lower_sj_river_feasibility.php>. Accessed: May 2, 2011

SJAFCA. Lower San Joaquin River, California Feasibility Study – Project Management Plan. Revision August 2009. November 17, 2009.

1.38 American River Common Features Post-Authorization Change and General Reevaluation Report

Project Type: Study

Location Information:

- **Region –** Lower Sacramento
- **Subregion –** Natomas Basin
- **Location –** Lower American River downstream from the Folsom Dam, Sacramento River downstream from the Natomas Cross Canal, and Natomas Cross Canal
- **Community Setting –** urban, nonurban areas

Project Proponents:

- **Potential Lead Non-Federal Agency –** To Be Determined
- **Potential Lead Federal Agency –** USACE
- **Potential Partners –** USACE, Board, SAFCA
- **Contact Information –**
  - Dan Tibitts, USACE
  - Ajala Ali, DWR
  - Pete Ghelfi, SAFCA

Description:

- **Purpose –** The Common Features Project was designed to strengthen the American River levees so they can safely pass a flow of 160,000 cfs. The General Reevaluation Report (GRR) will evaluate different aspects of the project. THE Post-Authorization Change (PAC) and GRR focus on changes to the Natomas Basin levees.
- **Concept –** Reevaluate the flood protection alternatives and improvements to the levee system along the lower American River downstream of the Folsom Dam, Sacramento River downstream from

the Natomas Cross Canal, and Natomas Cross Canal, and provide 200-year flood protection.

- **Relation to SPFC Facilities –** Levees along American River, Sacramento River downstream from the Natomas Cross Canal, and Natomas Cross Canal

Project Status: Ongoing. Final PAC and Interim GRR were released in October 2010.

Applicable Management Action(s): Flood Protection System Modification, O&M, Ecosystem Functions, Floodplain Management, Disaster Preparedness and Flood Warning

Contribution to CVFPP Goals:

- **Primary Goal –** Improve Flood Risk Management

- **Supporting Goals –** Improve O&M, Promote Ecosystem Functions, Improve Institutional Support, Promote Multi-Benefit Projects

Extent of Benefit Area: Local, regional, and systemwide benefits.

Potential to Provide Multi-Benefits:

- **Flood Damage Reduction Benefit –** The goal of the GRR is to identify a comprehensive plan that will lower the risk of flooding in and around the City of Sacramento, and provide 200-year flood protection.

- **Ecosystem Restoration –** In the Natomas Basin, the plan will provide incidental environmental benefits by capitalizing on the geographic scope and volume of soil borrow material necessary to support the required levee improvements. The plan includes a variety of landscape features that will have the substantial effect of expanding, connecting and enhancing the aquatic and upland habitat preserves that have been created in the Natomas Basin as part of the Natomas Basin Habitat Conservation Plan: reducing wildlife hazards in the vicinity of the airport through improved storm and surface water drainage; and promoting agricultural sustainability in the western portion of the basin through improvements to the existing agricultural irrigation system.

- **Water Supply –** The plan includes construction of new water supply wells as well as improvements to current water supply infrastructure.

- **Recreation and Other Benefits –** The levees along the Sacramento and American rivers effectively cut off public access to the rivers and their environmental and recreation amenities in many areas. This project offers an opportunity to reestablish connections to the river. Opportunities within the Natomas Basin are limited. Along with providing features that reduce flood risk, there is an opportunity to incorporate a bicycle trail on the levee system.

Implementation Cost: $15 million

Implementation Considerations:

- **Redirected Hydraulic Impacts –** Comprehensive plan tries to take negative impacts outside of the project area into consideration.
- **Adverse Environmental Impact and Regulatory Issues –** Temporary (construction related) negative impacts.
- **Other**

Associated Studies

None

References

U.S. Army Corps of Engineers. American River Common Features Project, Natomas Post Authorization Change Report And Interim General Reevaluation Report. October 2010. Available: <http://www.spk.usace.army.mil/projects/civil/americanriver/common_features/final_npac_oct_2010/final_natomas_pacr_oct_2010.pdf>

Sacramento Area Flood Control Agency . Draft Environmental Impact Statement/Draft Environmental Impact Report on the American River Watershed Common Features Project/Natomas Post-authorization Change Report/Natomas Levee Improvement Program, Phase 4b Landside Improvements Project. July 2010. Available: <http://www.safca.org/documents/NLIP%20main%20page%20stuff/2010JUL2.DEIR.DEIS.Phase4b/4bDEISDEIRPart1.pdf>

1.39 Project Title – Frazier Creek/Strathmore Creek Feasibility Study

Project Type: Study

Location Information:

- **Region** – Upper San Joaquin
- **Subregion** – Tulare County
- **Location** – Community of Strathmore and surrounding lands in Tulare County.
- **Community Setting** – Nonurban area and small community

Project Proponents:

- **Potential Lead Non-Federal Agency** – USACE
- **Potential Lead Federal Agency** – USACE
- **Potential Partners** – Board, County of Tulare
- **Contact Information** –
  - USACE PM – Michelle Williams
  - State PM – Efrain Escutia
  - Tulare PM – Jim May

Description:

- **Purpose** – Improve the level of flood protection for the community of Strathmore, State Route 65, bridges, railroads, and surrounding agricultural lands.
- **Concept** – This study will generate an Environmental Impact Statement/Environmental Impact Report (EIS/EIR and feasibility study to evaluate federal, State, and local interests in planning, designing, mitigating, and improving existing levee system of Frazier Creek/Strathmore Creek in Tulare County.
- **Relation to SPFC Facilities** – None

Project Status: Reconnaissance

Applicable Management Action(s): Floodplain Management – Floodproofing

Contribution to CVFPP Goals:

- **Primary Goal –** Improve Flood Risk Management
- **Supporting Goals –** Improve O&M, Promote Ecosystem Functions, Improve Institutional Support, Promote Multi-Benefit Projects

Extent of Benefit Area: Project would have local benefits

Potential to Provide Multi-Benefits:

- **Flood Damage Reduction Benefit**
- **Ecosystem Restoration**
- **Water Supply**
- **Recreation and Other Benefits**

Implementation Cost: $2.81 million

Implementation Considerations:

- **Redirected Hydraulic Impacts –** To Be Determined
- **Adverse Environmental Impact and Regulatory Issues –** To Be Determined
- **Other**

Associated Studies

None.

References

County of Tulare Resource Management Agency Meeting Agenda. October 2009. Available: <http://bosagendas.co.tulare.ca.us/MG306225/AS306228/AS306245/AI306345/DO306352/DO_306352.PDF>

Report of Activities of the Department of Water Resources. Presented December 2010. Available:

<http://www.floodplain.org/cmsAdmin/uploads/Final_Report_2010-12-03_DWR.pdf>

1.40 Lower Cache Creek Feasibility Study

Project Type: Study

Location Information:

- **Region –** Lower Sacramento
- **Subregion –** Lower Cache Creek
- **Location –** Lower Cache Creek, Yolo County, California, City of Woodland and vicinity
- **Community Setting –** Urban and nonurban areas

Project Proponents:

- **Potential Lead Non-Federal Agency –** To Be Determined
- **Potential Lead Federal Agency –** USACE
- **Potential Partners –** Board, City of Woodland
- **Contact Information –**
  - DWR PM – Efrain Escutia
  - USACE PM – Charles Austin
  - City of Woodland PM – Fran Borcalli

Description:

- **Purpose –** The study will continue efforts suspended in 2004 after local resistance to the USACE-selected flood barrier option alternative.
- **Concept –** The USACE will develop alternatives for a new feasibility study to determine if there is a National Economic Development plan that is federally justified and modifies the SPFC.
- **Relation to SPFC Facilities –** Yolo Bypass/Cache Creek Settling Basin and weir.

Project Status: Reconnaissance

Applicable Management Action(s): Flood Protection System Modification.

Contribution to CVFPP Goals:

- **Primary Goal –** Improve Flood Risk Management
- **Supporting Goals –** Improve O&M, Promote Ecosystem Functions, Improve Institutional Support, Promote Multi-Benefit Projects

Extent of Benefit Area: Local and regional benefits.

Potential to Provide Multi-Benefits:

- **Flood Damage Reduction Benefit** – To Be Determined
- **Ecosystem Restoration –** To Be Determined
- **Water Supply –** To Be Determined
- **Recreation and Other Benefits –** To Be Determined

Implementation Cost: $5.5 million.

Implementation Considerations:

- **Redirected Hydraulic Impacts –** Yolo Bypass, Cache Creek Settling Basin and weir.
- **Adverse Environmental Impact and Regulatory Issues –** To Be Determined
- **Other**

Associated Studies

Original Feasibility Study that was ultimately rejected. October 2002. Lower Cache Creek, Yolo County, Ca, City Of Woodland and Vicinity: Draft Feasibility Report for Potential Flood Damage

Reduction Project. http://www.spk.usace.army.mil/projects/civil/lowercachecreek/feas.html

Original EIS. March 2003. Lower Cache Creek Environmental Impact Statement/Environmental Impact Report. http://www.spk.usace.army.mil/projects/civil/lowercachecreek/eiseir.html

References

U.S. Army Corps of Engineers (USACE). Lower Cache Creek, Yolo County, City Of Woodland and Vicinity, Ca Feasibility Study Review Plan. April 2010 (Rev.). Available:<http://www.spk.usace.army.mil/organizations/cespk-pd/Review%20Plans/LCC_RP_.pdf>

1.41 Merced County Streams Feasibility Study and General Reevaluation Report

Project Type: Study

Location Information:

- **Region** – Upper San Joaquin
- **Subregion** – Merced County
- **Location** – Black Rascal Creek and Bear Creek
- **Community Setting** – Urban and nonurban

Project Proponents:

- **Potential Lead Non-Federal Agency** – To Be Determined
- **Potential Lead Federal Agency** – USACE
- **Potential Partners** – USACE, Board, Merced County
- **Contact Information** –
    - Katie Huff, USACE
    - Ajala Ali, DWR
    - Kellie Jacobs, Merced Public Works

Description:

- **Purpose** – The purpose of this project is to evaluate options to increase the level of flood protection from a 50-year event to 200 years for the Merced urban area.
- **Concept** – Feasibility study would study options for flood protection project on Black Rascal Creek, which would also offer protection along Bear Creek.
- **Relation to SPFC Facilities** – Identify which SPFC facilities would be modified by this project.

Project Status: Reconnaissance level. Merced County is currently pursuing an effort with the DWR, to have the State sign on to the project as the primary non-federal partner.

Applicable Management Action(s): Flood Protection System Modification

Contribution to CVFPP Goals:

- **Primary Goal –** Improve Flood Risk Management
- **Supporting Goals –** Improve O&M, Promote Ecosystem Functions, Improve Institutional Support, Promote Multi-Benefit Projects

Extent of Benefit Area: Project has local and regional benefits.

Potential to Provide Multi-Benefits:

- **Flood Damage Reduction Benefit –** The primary goal of the study is to determine how 200-year flood protection can be achieved, while providing a viable alternative to the Haystack Dam project.
- **Ecosystem Restoration –** To Be Determined
- **Water Supply –** To Be Determined
- **Recreation and Other Benefits –** To Be Determined

Implementation Cost: $3 million.

Implementation Considerations:

- **Redirected Hydraulic Impacts –** Not applicable
- **Adverse Environmental Impact and Regulatory Issues –** Not applicable
- **Other**

Associated Studies

None.

References

MCAG Fact Sheet. Available: <http://www.mcagov.org/onevoice/2010/priorities/federal/Waterflood.pdf>

1.42 Rock Creek/Keefer Slough Feasibility Study

Project Type: Study

Location Information:

- **Region –** Upper Sacramento
- **Subregion –** Eastside/Westside Tributaries
- **Location –** The study area is located in Butte County and includes Rock Creek, Keefer Slough, portions of the City of Chico with an estimated population of 87,713, and the town of Nord.
- **Community Setting –** Urban and nonurban

Project Proponents:

- **Potential Lead Non-Federal Agency –** To Be Determined
- **Potential Lead Federal Agency –** USACE
- **Potential Partners –** USACE, Board, Butte County
- **Contact Information –**
  - Brandon Muncy, USACE
  - Ajala Ali, DWR
  - Mike Crump, Butte County

Description:

- **Purpose –** The feasibility study will improve the level of flood protection for the communities of Chico, Nord, State Routes 99 and 32, and surrounding agricultural land.
- **Concept –** The study will identify flood risk management, recreational, and ecosystem restoration improvements up to at least a 200-year level of protection. The study will identify structural and nonstructural alternatives to increase flood protection levels and evaluate further federal interest in pursuing alternatives based upon costs, benefits, environmental effects, and local interest and support.

Alternatives analyzed during the feasibility investigation will be a combination of one or more flood control and ecosystem restoration measures identified during the reconnaissance phase; additional measures may be considered. These alternative measures include (1) setback levees and stream channel improvements, (2) environmental restoration measures, (3) bypass and diversion structures, and (4) detention storage measures. The goal of this project is to provide the greatest environmental benefits possible in conjunction with the proposed flood control project. Primary objectives include reducing flood risk and property damages, preserving existing resources, improving water quality, restoring wetlands, increasing riparian and riverine habitat, and reducing cobble and sediment transport.

- **Relation to SPFC Facilities –** Identify which SPFC facilities that would modified by this project.

Project Status: Feasibility Study

Applicable Management Action(s): Additional Floodplain and Reservoir Storage, Flood Protection System Modification, Ecosystem Functions

Contribution to CVFPP Goals:

- **Primary Goal –** Improve Flood Risk Management

- **Supporting Goals –** Promote Ecosystem Functions Promote Multi-Benefit Projects

Extent of Benefit Area: Project has local and regional benefits.

Potential to Provide Multi-Benefits:

- **Flood Damage Reduction Benefit –** The project goal is to improve the level of flood protection for the communities of Chico, Nord, State Routes 99 and 32, and surrounding agricultural land.

- **Ecosystem Restoration –** Ecosystem Restoration Improvements will be included. Significant issues to be analyzed in depth in the EIS/EIR include appropriate levels of the flood damage reduction, adverse effects on vegetation and wildlife resources, special-status species, esthetics, cultural resources, recreation, and cumulative effects of related projects in the study area.

- **Recreation and Other Benefits –** Recreational Improvements will be included.

Implementation Cost: $3 million.

Implementation Considerations:

- **Redirected Hydraulic Impacts –** None
- **Adverse Environmental Impact and Regulatory Issues** – To Be Determined
- **Other**

Associated Studies

The USACE initiated but did not complete a reconnaissance study in 2002.

References

CVFP Board Approval of Letter of Intent for the Rock Creek/Keefer Slough Feasibility Study. Available: <http://www.cvfpb.ca.gov/meetings/2010/092310Item8K_Rock%20Creek_FeasStudyLtrofIntent.pdf>

1.43 Sutter Basin Feasibility Study

Project Type: Study

Location Information:

- **Region –** Lower Sacramento
- **Subregion –** Sutter Basin
- **Location –** The study area is that area hydraulically connected to Yuba City, California, and roughly bounded by the Feather River, Sutter Bypass, Wadsworth Canal, Sutter Buttes, and Cherokee Canal. The elongated, irregularly shaped study area covers about 284 square miles and is about 43 miles long, north to south, and up to 9 miles wide, east to west. Flood waters potentially threatening the study area originate from the Feather River watershed or the upper Sacramento River watershed, above Colusa Weir. These waterways have drainage areas of 5,921 and 12,090 square miles, respectively
- **Community Setting –** Urban and nonurban areas

Project Proponents:

- **Lead Non-Federal Agency –** To Be Determined
- **Potential Lead Federal Agency –** USACE
- **Potential Partners –**Board, Sutter-Butte Flood Control Agency
- **Contact Information –**
  - Laura Whitney, USACE
  - Michael Musto, DWR
  - Mike Inamine, Sutter-Butte Flood Control Agency

Description:

- **Purpose –** This multipurpose feasibility study aims to address levee improvement measures for existing levee systems as well as environmental restoration and recreation opportunities.
- **Concept –** The study will investigate measures to improve the level of flood protection for Yuba City to a 200-year level. The study will also

evaluate existing flood protection and determine if further protection is feasible for the area located within the boundaries of the Sacramento River Flood Control Project in Butte and Sutter counties. Alternatives to be considered during the feasibility study include reoperation of upstream reservoirs, reconstruction of project levees, constructing a ring levee around Yuba City, modification of the Sutter Bypass, modification of the Fremont Weir and others.

- **Relation to SPFC Facilities –** Levees of the Feather River, Sutter Bypass, and Cherokee Canal adjacent to the project

Project Status: Feasibility study

Applicable Management Action(s): Flood Protection System Modification, Ecosystem Functions

Contribution to CVFPP Goals:

- **Primary Goal –** Improve Flood Risk Management
- **Supporting Goals –** Promote Ecosystem Functions, Promote Multi-Benefit Projects

Extent of Benefit Area: local, regional, and systemwide benefits

Potential to Provide Multi-Benefits:

- **Flood Damage Reduction Benefit** – The study area is almost completely bounded by project levees and the high ground of the Sutter Buttes. Consequently, the primary flood-related problems in the study area are associated with potential levee failure. Opportunities for reducing flood risk could be associated with increasing levee integrity, building new levees, altering waterway flow regimes as affected by upstream reservoirs, providing new bypasses, and nonstructural measures to accommodate flood events and improve public safety.

- **Ecosystem Restoration –** The ecosystem restoration and recreation measures that are being considered would be secondary to the flood damage reduction objective. If possible, the study will include environmental features beyond the scope of mitigation, and potential funding sources for ecosystem restoration are being researched. Opportunities to restore degraded ecosystems are those that would reconnect former floodplains and wetlands with the waterways from which they have been separated, regrading mine tailing areas, enhancing or protecting interior drainage corridors, and by operating reservoirs to provide more "natural" flow regimes.

- **Recreation and Other Benefits –** A secondary goal of the study will be to identify increased recreation opportunities.

Implementation Cost: $12 million

Implementation Considerations:

- **Redirected Hydraulic Impacts –** Implementation would result in positive effects on flood protection to the local community. No adverse hydraulic effects are anticipated to occur
- **Adverse Environmental Impact and Regulatory Issues –** Only temporary (construction-related) negative impacts are expected as a result of this project.
- **Other**

Associated Studies

None.

References

U.S. Army Corps of Engineers (USACE). Sutter Basin Flood Risk Management, Ecosystem Restoration and Recreation Feasibility Study Review Plan. April 2010 (Rev.). Available: <*http://www.spk.usace.army.mil/organizations/cespk-pd/Review%20Plans/Sutter_Review_Plan_28apr10.pdf*>

Final California's Central Valley Flood System Improvement Framework. February 2009. Available: <http://www.nfrmp.us/docs/CACVFloodSystemImprovementFramework_2-27-09FINAL.pdf>

Report of Activities of the Department of Water Resources. Presented December 2010. Available: <http://www.floodplain.org/cmsAdmin/uploads/Final_Report_2010-12-03_DWR.pdf>

1.44 West Sacramento Area Flood Control Agency Project and General Reevaluation Report

Project Type: Study

Location Information:

- **Region** – Lower Sacramento
- **Subregion** – West Sacramento
- **Location –** Located in eastern Yolo County in the north central region of California's Central Valley. The study area approximately corresponds with the city limit for the City of West Sacramento comprising 13,000 acres of mixed-use land and an estimated population of 44,000 residents
- **Community Setting –** Urban and nonurban areas

Project Proponents:

- **Potential Lead Non-Federal Agency** – To Be Determined
- **Potential Lead Federal Agency** – USACE
- **Potential Partners** – Board, West Sacramento Area Flood Control Agency (WSAFCA)
- **Contact Information** –
  - Elizabeth Henderson, USACE
  - Michael Musto, DWR
  - Michael Bessette, WSAFCA

Description:

- **Purpose –** The Water Resources Development Act (WRDA) of 1992 and the Energy and Water Development and Appropriations Act (EWDAA) of 1999 authorized the West Sacramento Project, although that project is largely constructed, it is not complete. Subsequent to authorization, additional information regarding deep under seepage of levees has become available. The project partners have requested additional investigation into the remaining flood-related issues in the study area. USACE has determined that the subsequent investigation be pursued as a GRR.

- **Concept –** The GRR is being conducted to study future work necessary to provide a minimum of 200-year level of protection for the City of West Sacramento. Elements included in the GRR are: hydraulic and hydrology studies, geotechnical analysis, environmental documentation, economic analysis, cultural resources studies, cost estimating and value engineering, and public involvement and outreach.

- **Relation to SPFC Facilities –** Levees of the Sacramento Bypass, Yolo Bypass, Sacramento River, and Sacramento Deep Water Ship Channel. Sacramento Weir.

Project Status: Feasibility Study

Applicable Management Action(s): Flood Protection System Modification, Ecosystem Functions

Contribution to CVFPP Goals:

- **Primary Goal –** Improve Flood Risk Management

- **Supporting Goals –** Promote Ecosystem Functions, Promote Multi-Benefit Projects

Extent of Benefit Area: Local and regional benefits.

Potential to Provide Multi-Benefits:

- **Flood Damage Reduction Benefit** – Potential flood risk management measures range from modifying and/or increasing conveyance through raising and strengthening levees, widening channels and bypass areas, and modifying weirs and bypasses. Nonstructural floodplain management measures would also be considered.

- **Ecosystem Restoration –** Primary ecosystem problems are (1) construction of levees and land-use changes have separated rivers from historic floodplains, and (2) construction of reservoirs has altered historic flow regimes, both of which have resulted in loss of floodplain process and associated native habitats. Technical analyses completed to date within the proposed study area indicate the potential to restore the ecosystem with specific benefits to the following special-status species: Swainson's hawk; Cooper's hawk; Valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*); Giant garter snake; Central Valley steelhead; Sacramento River winter-run Chinook salmon;

Central Valley spring-run Chinook salmon ESU; Central Valley fall-/late fall-run Chinook salmon ESU; rose-mallow (*Hibiscus moscheutos*); and, Sanford's arrowhead (*Sagittaria sanfordii*). The project may also have high stakeholder and resource agency interest due to the existence of encroachments and vegetation on existing levees and potential impacts to endangered species habitat, depending on how the vegetation and encroachment issues are addressed.

- **Recreation and Other Benefits –** A secondary goal of the study will be to identify increased recreational opportunities.

Implementation Cost: $5.7 million

Implementation Considerations:

- **Redirected Hydraulic Impacts –** Implementation would result in positive effects on flood protection to the local community. No adverse hydraulic effects are anticipated to occur.

- **Adverse Environmental Impact and Regulatory Issues –** Only temporary (construction related) negative impacts are expected as a result of this project.

- **Other**

Associated Studies

West Sacramento Project, West Sacramento, California: Design Memorandum and Environmental Assessment/Initial Study – USACE (May 1995)

References

U.S. Army Corps of Engineers (USACE). West Sacramento, California Flood Risk Management and Ecosystem Restoration General Reevaluation Report Review Plan. April 2010. Available: <http://www.spk.usace.army.mil/organizations/cespk-pd/Review%20Plans/West_Sac_Review_Plan_30April2010.pdf>

Final California's Central Valley Flood System Improvement Framework. February 2009. Available:< http://www.nfrmp.us/docs/CACVFloodSystemImprovementFramework_2-27-09FINAL.pdf>

1.45 West Stanislaus County Orestimba Creek Feasibility Study

Project Type: Study

Location Information:

- **Region** – Lower San Joaquin
- **Subregion** – Stanislaus County
- **Location –** West side of the San Joaquin River in Stanislaus County, California, near the City of Newman.
- **Community Setting** – Nonurban and small community

Project Proponents:

- **Potential Lead Non-Federal Agency –** To Be Determined
- **Potential Lead Federal Agency** – USACE
- **Potential Partners** – USACE, City of Newman, Board, Stanislaus County
- **Contact Information –**
  - Michelle Williams, USACE
  - Ajala Ali, DWR
  - Matt Machado, Stanislaus County

Description:

- **Purpose –** The Orestimba Creek Feasibility Study will evaluate feasible flood protection alternatives for the City of Newman and the surrounding agricultural areas. State and local agencies are pursuing federal authorization of a locally preferred plan that improves the level of flood protection from 4 years to 200years.
- **Concept** – The Orestimba Creek channel is not able to convey a flood event larger than a 10-year magnitude; therefore, the creek does not currently play a major role in conveying flood flows. The existing channel conveys less than 20 percent of the 100-year discharge. The remainder of the flow runs overland through agricultural and residential

properties on its way to the San Joaquin River, creating shallow, sheet-flow flooding. The project is a General Investigations study undertaken to evaluate structural and nonstructural flood risk management measures, including channel modifications, construction of new levees, and construction of an interceptor canal.

As the evaluation of alternatives for the feasibility study progressed, the locally favored alternative of Upstream Dry Dam was not economically justified. This alternative also has environmental and safety concerns that would be highly controversial if this alternative were carried forward. The most acceptable alternative has proven to be a combination of widening the stream channel to double its capacity, and constructing chevron levees 3 to 4 feet high around the town to protect it from flooding.

- **Relation to SPFC Facilities –** Not applicable

Project Status: Feasibility study

Applicable Management Action(s): Flood Protection System Modification

Contribution to CVFPP Goals:

- **Primary Goal** – Improve Flood Risk Management
- **Supporting Goals** – Not applicable

Extent of Benefit Area: Local benefits.

Potential to Provide Multi-Benefits:

- **Flood Damage Reduction Benefit –** The preferred alternative is designed to be protective of the town (Chevron Levees) and reduce the flood threat to surrounding agricultural areas (channel widening).
- **Ecosystem Restoration –** To Be Determined
- **Water Supply –** To Be Determined
- **Recreation and Other Benefits –** To Be Determined

Implementation Cost: $6.8 million

Implementation Considerations:

- **Redirected Hydraulic Impacts –** Localized increases in the depth of flooding up to half a foot may occur in areas outside of the chevron levee.

- **Adverse Environmental Impact and Regulatory Issues –** A combined EA/IS is being developed for this study. Potential impacts will be identified through this process.

- **Other**

Associated Studies

None.

References

U.S. Army Corps of Engineers (USACE). Orestimba Creek, California Flood Risk Management Feasibility Study Review Plan. April 2010. Available: <http://www.spk.usace.army.mil/organizations/cespk-pd/Review%20Plans/Orestimba_Creek_Review_Plan_30apr10.pdf>

USACE. Orestimba Creek Feasibility Study Team Recognized for Innovative Thinking. September 2009. http://www.army.mil/-news/2009/09/18/27573-orestimba-creek-feasibility-study-team-recognized-for-innovative-thinking/

1.46 White River/Deer Creek Feasibility Study

Project Type: Study

Location Information:

- **Region –** Upper San Joaquin
- **Subregion –** Tulare County
- **Location –** Community of Earlimart and 300 square miles of farmland in Tulare County
- **Community Setting –** Nonurban area and small community

Project Proponents:

- **Potential Lead Non-Federal Agency –** To Be Determined
- **Potential Lead Federal Agency –** USACE
- **Potential Partners –** USACE, Board**,** County of Tulare
- **Contact Information –**
  - USACE PM – Michelle Williams
  - State PM – Efrain Escutia
  - Tulare PM – Jim May

Description:

- **Purpose –** Improve the level of flood protection for the community of Earlimart, State Route 99, railroads, federal aqueduct, and 300 square miles of farmland in Tulare County.
- **Concept –** This study will generate an EIS/EIR and feasibility study to evaluate federal, State, and local interests in planning, designing, mitigating, and improving existing levee system of White River and Deer Creek in Tulare County.
- **Relation to SPFC Facilities –** None.

Project Status: Reconnaissance level

Applicable Management Action(s): Flood Protection System Modification

Contribution to CVFPP Goals:

- **Primary Goal –** Improve Flood Risk Management
- **Supporting Goals –** Improve O&M, Promote Ecosystem Functions, Improve Institutional Support, Promote Multi-Benefit Projects

Extent of Benefit Area: Project would have local benefits.

Potential to Provide Multi-Benefits:

- **Flood Damage Reduction Benefit** – To Be Determined
- **Ecosystem Restoration** – To Be Determined
- **Water Supply** – To Be Determined
- **Recreation and Other Benefits –** To Be Determined

Implementation Cost: $3.13 million.

Implementation Considerations:

- **Redirected Hydraulic Impacts** – To Be Determined
- **Adverse Environmental Impact and Regulatory Issues –** To Be Determined
- **Other**

Associated Studies None.

References

County of Tulare Resource Management Agency Meeting Agenda. October 2009. Available: <http://bosagendas.co.tulare.ca.us/MG306225/AS306228/AS306245/AI306345/DO306352/DO_306352.PDF>

Report of Activities of the Department of Water Resources. Presented December 2010. Available: <http://www.floodplain.org/cmsAdmin/uploads/Final_Report_2010-12-03_DWR.pdf>

1.47 Yuba River Basin Project General Reevaluation Report

Project Type: Study

Location Information:

- **Region** – Lower Sacramento
- **Subregion** – Yuba
- **Location –** Western Yuba County 50 miles north of Sacramento, California. The study area is a portion of the Yuba-Feather-Bear Rivers watershed.
- **Community Setting –** Urban, nonurban area, and small community

Project Proponents:

- **Potential Lead Non-Federal Agency –** To Be Determined
- **Potential Lead Federal Agency –** USACE
- **Potential Partners –** USACE, Yuba County Water Agency, Reclamation District 784, Board
- **Contact Information –**
  - DWR PM Efrain Escutia
  - USACE PM Mark Ellis
  - YCWA PM Tom Engler

Description:

- **Purpose –** The GRR will reevaluate the flood protection alternatives and improvements to the levee system and channels protecting the urban areas of Marysville, Linda, Olivehurst, Arboga, and surrounding agricultural land and provide 200-year flood protection.
- **Concept –** Although the 1998 Final Feasibility Study identified needed project elements, the USACE and Board are reevaluating the project and preparing a GRR to expand the project area to include the Goldfields, the Feather River from River Mile (RM) 20 to the Bear River confluence, the Bear River from the Feather River confluence to

the Western Pacific Interceptor Canal, and the Western Pacific Interceptor Canal. In addition, the study will evaluate increasing the level of flood protection to 200-year for the Yuba River Basin area. Ecosystem restoration as a secondary project purpose is also under study.

- **Relation to SPFC Facilities –** Not applicable

Project Status: Feasibility study

Applicable Management Action(s): Flood Protection System Modification

Contribution to CVFPP Goals:

- **Primary Goal** – Improve Flood Risk Management
- **Supporting Goals** – Improve O&M, Promote Ecosystem Functions, Improve Institutional Support, Promote Multi-Benefit Projects.

Extent of Benefit Area: Local and regional benefits.

Potential to Provide Multi-Benefits:

- **Flood Damage Reduction Benefit –** To Be Determined
- **Ecosystem Restoration–** To Be Determined
- **Water Supply–** To Be Determined
- **Recreation and Other Benefits–** To Be Determined

Implementation Cost: $16 million.

Implementation Considerations:

- **Redirected Hydraulic Impacts –** Lower Feather River
- **Adverse Environmental Impact and Regulatory Issues –** Unknown

Associated Studies

Marysville Ring Levee Engineering Documentation Report. April 2010. Available: <ftp://ftp.usace.army.mil/pub/spk/Marysville_Ring_levee/PPA/MRL%20EDR%20Main%20Report.pdf>

References

U.S. Army Corps of Engineers (USACE). Yuba River basin, California Flood Risk Management General Reevaluation Study Review Plan. April 2010 (Rev.). Available: http://www.spk.usace.army.mil/organizations/cespk-pd/Review%20Plans/YUBA_RIVER_BASIN_GRR_REVIEW_PLAN_%20April2010.pdf

Final California's Central Valley Flood System Improvement Framework. February 2009. Available: http://www.nfrmp.us/docs/CACVFloodSystemImprovementFramework_2-27-09FINAL.pdf

1.48 Mid-Valley Area Levee Reconstruction Project

Project Type: System Modifications

Location Information:

- **Region –** Lower Sacramento
- **Subregion** – Sacramento
- **Location –** Sutter and Sacramento Counties
- **Community Setting** – Urban

Project Proponents:

- **Potential Lead Non-Federal Agency –** DWR
- **Potential Lead Federal Agency** – USACE
- **Potential Partners –** Board, seven local agencies and counties, including Knights Landing Drainage District and Yolo County

Contact Information – To Be Determined

Description:

- **Purpose –** The Mid-Valley Project is part of the Knights Landing Ridge Drainage District. The project proposes to repair levees at 13 sites northwest of the City of Sacramento that have required floodfighting or experienced seepage and boils during previous flood events. These levees are integral to the systemwide performance of the Sacramento River Flood Control Project and provide direct protection to the towns of Knights Landing, Verona, and Nicholas, indirect flood protection to the cities of Sacramento and West Sacramento, while also protecting 93,000 acres of farmland and associated infrastructure that support the Sacramento Valley's capacity as one of the most productive agricultural regions of the world. The repair of levees in Area 3 will nearly triple the level of flood protection afforded the town of Knights Landing and the adjacent agricultural areas.

- **Concept –** Restore levees to design standards on the Feather and Sacramento rivers and tributaries just north of Sacramento. Project sites extend from the Tisdale Bypass to the Sacramento Bypass and include levees of the Sacramento River, Feather River, Yolo and Sutter bypasses, and Knights Landing Ridge Cut.

Area 3 levee reconstruction involves 3.4 miles of levee repair along the Knights Landing Ridge Cut and 1.3 miles of levee repair along the west bank of the Sacramento River. The repair of 17 sites located within Area 1 was completed in 1998. The remaining 13 sites in 3 areas across Yolo and Sutter counties are still in need of repair. These repairs include seepage and stability berms, levee crown restoration, slurry cutoff walls, interior drains, and encroachment relocations.

The USACE is creating a Limited Reevaluation Report for this project due in 2012. The environmental document is in the process of being updated.

- **Relation to SPFC Facilities –** Tisdale Bypass, Sacramento Bypass, levees of the Sacramento River, Feather River, Yolo and Sutter bypasses, Knights Landing Ridge Cut.

Project Status: No additional federal funding provided as of November 2011. The Corps is operating on carryover funds to complete designs for the six sites within Area 3. The Corps will continue to request federal funding for this project.

Applicable Management Action(s): System Modifications – Levees/Floodwalls/Hydraulic Structures

Contribution to CVFPP Goals:

- **Primary Goal –** Improve Flood Risk Management
- **Supporting Goals –** Improve O&M, Improve Institutional Support

Extent of Benefit Area: Project would have local, regional, and systemwide benefits.

Potential to Provide Multi-Benefits:

- **Flood Damage Reduction Benefit –** Provide direct protection to the towns of Knights Landing, Verona, and Nicholas, indirect flood protection to the Cities of Sacramento and West Sacramento. Also protects 93,000 acres of farmland and associated infrastructure that support the Sacramento Valley's capacity as one of the most productive agricultural regions of the world.
- **Ecosystem Restoration –** None

- **Water Supply –** None
- Recreation and Other Benefits – None

Implementation Cost: $54 million

Implementation Considerations:

- **Redirected Hydraulic Impacts**. – Levee restoration and reconstruction project. No significant hydraulic impact is anticipated.
- **Adverse Environmental Impact and Regulatory Issues –** To Be Determined
- **Other**

Associated Studies:

None

References

DWR. California Department of Water Resources FloodSafe Federal Appropriations Project List (Revised as of February 14, 2011). Agenda Item No. 7. Available: <http://www.cwc.ca.gov/docs/Agenda_Item_7_%20re%20DWR%20Approps%20FY09-FY11%20(2-14-11%20final).pdf>

Reclamation District 108. Mid-Valley Project. Available: <http://rd108.org/flood-control/mid-valley-project>

USACE. California's Central Valley Flood System Improvement Framework. February 27, 2009. Available: <http://www.nfrmp.us/docs/CACVFloodSystemImprovementFramework_2-27-09FINAL.pdf>

DWR. Report of Activities of the Department of Water Resources. Presented before the Central Valley Flood Protection Board on December 3, 2010. Available: <http://www.floodplain.org/cmsAdmin/uploads/Final_Report_2010-12-03_DWR.pdf>

1.49 Sacramento River Flood Control System Evaluation

Project Type: System Modifications

Location Information:

- **Region –** Upper/Lower Sacramento River
- **Subregion –** [all subregions]
- **Location –** All levees along the Sacramento River
- **Community Setting –** Nonurban

Project Proponents:

- **Potential Lead Non-Federal Agency** – DWR
- **Potential Lead Federal Agency** – USACE
- **Potential Partners** –To Be Determined
- **Contact Information** –
  - Tom Karvonen, USACE
  - Michael Musto, DWR

Description:

- **Purpose** – The Sacramento River Flood Control System Evaluation was prepared by the USACE and initiated in 1986 to determine the extent of levee reconstruction required to bring the system to original design standards. The evaluation is divided into five phases or areas. Work on Phase I, the Sacramento Urban Area Reconstruction Project, was completed in 1993. Work on Phase II, the Marysville/Yuba City Area, was scheduled for completion in 1999. Phase III (Mid-Valley Area), Phase IV (Lower Sacramento Area), and V (Upper Sacramento Area) completed engineering and design, and construction schedules should have been developed.

- **Concept** – One of the areas identified in the report are the deficiencies in the structural integrity of the levees along the Feather and Yuba rivers, indicating that the level of flood protection provided by these levees is lower than previously thought. Without the remedial recommendations identified in this report, Sutter County is obliged to acknowledge the lower level of protection. This could be a significant constraint on planned growth in the study area. The area of Sutter County impacted extends from the Butte/Sutter County line along the Feather River west to the Sutter Bypass and south to their confluence.

Phase III (Mid-Valley Study area) includes portions in the Sacramento River (RMs 70 to 118), Feather River, Knights Landing Ridge Cut, Sutter Bypass, and Yolo Bypass. USACE is proposing to construct levee stability features at 13 sites. Major features include seepage stability berms, levee crown restoration, levee slope reshaping, and slurry trench cutoff walls.

- **Relation to SPFC Facilities –** Levees along the Sacramento River

Project Status: Recent flood events have shown that the existing level of flood protection is significantly less than previously thought. The State of California has requested a reevaluation by the USACE of the entire levee system. Due to lack of federal funding, the project feasibility study is not complete.

Applicable Management Action(s): System Modifications – Levees/Floodwalls/Hydraulic Structures

Contribution to CVFPP Goals:

- **Primary Goal –** Improve Flood Risk Management
- **Supporting Goals –** Improve O&M, Improve Institutional Support, Promote Multi-Benefit Projects

Extent of Benefit Area: Project would have local, regional, and systemwide benefits.

Potential to Provide Multi-Benefits:

- **Flood Damage Reduction Benefit –** Repairing the levees would reduce flood risk potential for communities, businesses, and land nearby.
- **Ecosystem Restoration –** None
- **Water Supply –** None
- **Recreation and Other Benefits –** None

Implementation Cost: $12 million

Implementation Considerations:

- **Redirected Hydraulic Impacts –** Little to no negative hydraulic impacts. The levees should be repaired to their designed standards.
- **Adverse Environmental Impact and Regulatory Issues –** Need to refer to EIR. Adverse environmental impacts may be insignificant.
- **Other**

Associated Studies

None.

References

California Natural Resources Agency. Sutter County General Planning. Available: <http://ceres.ca.gov/planning/genplan/sutter/facilities3.html>

U.S. Army Corps of Engineers (USACE). Sacramento River Flood Control Project, California, Mid-Valley Area, Phase III. Available:< http://www.stormingmedia.us/47/4715/A471524.html>

USACE. Post-Flood Asessment for 1983, 1986, 1995, and 1997.Chapter 3 – Central Valley Flood Management Systems. Available: < http://www.auburndamcouncil.org/pages/pdf-files/3-cv_floodmgmt_system.pdf>

1.50 Hamilton City Flood Damage Reduction and Ecosystem Restoration Project

Project Type: System Modifications

Location Information:

- **Region** – Upper Sacramento
- **Subregion** – Hamilton
- **Location –** Glenn County; Along the Sacramento River just south east of Hamilton City
- **Community Setting** – Urban

Project Proponents:

- **Potential Lead Non-Federal Agency –** DWR (District 2140)
- **Potential Lead Federal Agency** – USACE
- **Potential Partners** – Glenn-Colusa Irrigation District, The Nature Conservancy
- **Contact Information** – Lee Ann Grigsby-Puente

Description:

- **Purpose** – Hamilton City and the surrounding agricultural lands are subject to frequent flooding from the Sacramento River. The only existing protection is from the substandard, private J Levee. The current J Levee protects the town of Hamilton City, which has a population of approximately 2,070 residents. There are approximately 758 properties (residential, commercial, and agricultural) that are at risk of flooding if the J Levee were to fail.
- **Concept –** The Hamilton City Flood Damage Reduction and Ecosystem Restoration Project is defined as:
    - Construction of a new 6.8-mile-setback levee.
    - The reconnection of 1,480 acres to floodplain between the new set back levee and the river, of which approximately 1,361 acres will be restored to native riparian habitat.

- **Relation to SPFC Facilities –** Sacramento River levee around Hamilton City

Project Status: Under limited federal funding and grant fund from the Nature Conservancy, the USACE design and the Limited Reevaluation Report (LRR) are in progress. The construction has not been planned due to lack of federal funding. The Project Partnership Agreement (PPA) between the Federal and Non-Federal partners has not been signed.

Applicable Management Action(s): System Modifications – Levees/Floodwalls/Hydraulic Structures

Contribution to CVFPP Goals:

- **Primary Goal –** Improve Flood Risk Management

- **Supporting Goals –** Improve O&M, Promote Ecosystem Functions, Improve Institutional Support, Promote Multi-Benefit Projects

Extent of Benefit Area: Project has local, regional, and systemwide benefits.

Potential to Provide Multi-Benefits:

- **Flood Damage Reduction Benefit –** The Project would replace the existing J Levee with a new levee 6.8 miles long that is set back from the Sacramento River and would protect approximately 3,700 acres, including the town of Hamilton City.

- **Ecosystem Restoration –** Ecosystem restoration component of the project will provide 1,361 acres of potential breeding and nesting areas for avian species. The project adjoins 666 acres of restored habitat on the Sacramento River National Wildlife Refuge (SRNWR) and it will expand and enhance habitat for the 35 federally listed species on the SRNWR. The project also adjoins 463 acres of restored habitat on the state-owned Sacramento River Wildlife Area and is directly across the river from the California Department of Parks and Recreation’s Bidwell-Sacramento River State Park. Project completion will result in the largest area of connected, viable wildlife habitat (approximately 4,000 acres) within the Sacramento River Project.

- **Water Supply –** None

- **Recreation and Other Benefits –** One of the two primary goals of the project, however, is to protect agricultural land from frequent flooding events.

Implementation Cost: $53,405,750

Implementation Considerations:

- **Redirected Hydraulic Impacts** – Implementation would result in positive effects on flood protection to the local community. No adverse hydraulic effects would occur.

- **Adverse Environmental Impact and Regulatory Issues –** There will be temporary disturbance to vegetation and wildlife, but these will return after construction is completed. Increased sediment contribution to the river during construction and removal of the levee may impact fisheries but will only be temporary and project will use best management practices to mitigate.

- Other

Associated Studies

USACE. Hamilton City Flood Damage Reduction and Ecosystem Restoration, California. Final Feasibility Report and EIR/EIS. July 2004.

References

Sacramento River Conservation Area Forum. Hamilton City Flood Damage Reduction and Ecosystem Restoration Project website. Available: < http://www.sacramentoriver.org/srcaf/index.php?id=hamilton_city>

USACE. Hamilton City Flood Damage Reduction & Ecosystem Restoration Project Status Report. April 21, 2011. Available: <http://www.sacramentoriver.org/srcaf/publications/hamilton_city_docs/Hamilton_City_presentation_(Karvonen_2011).pdf>

Central Valley Non-Structural Grant Program Project Summary.

1.51 Putah Creek Flood Reduction and Habitat Improvement Project

Project Type: Floodplain Management

Location Information:

- **Region** – Lower Sacramento
- **Subregion** – Solano/Yolo County
- **Location –** Downstream from the Putah Creek Diversion Dam in Solano/Yolo County
- **Community Setting** – Nonurban

Project Proponents:

- **Potential Lead Non-Federal Agency –** Solano County Water Agency
- **Potential Lead Federal Agency** – USACE
- **Potential Partners** – City of Davis, DFG, DWR
- **Contact Information –** Rich Marovich, Solano County Water Agency

Description:

- **Purpose –** The main flood risk is due to overtopping and failure of Putah Diversion Dam due to reduced flood flow capacity of the channel below the dam. The dam was designed to pass 34,000 cfs, a 1-in-100-year event. The current capacity is 17,000 cfs, a 1-in-25-year event due to increased channel roughness caused by overgrowth of vegetation in the channel. If the dam is overtopped, it could be undermined in the receding limb of flood flows, interrupting water deliveries to 300,000 municipal water users and irrigation water for 70,000 acres of farmland in Solano County. Eight hundred feet of Putah Creek Road east of Highway 505 are also at risk of failure.
- **Concept –** The project will be completed in four major phases.
  - Provide planning, communications, stream modeling, and civil engineering.

- Complete CEQA and National Environmental Policy Act permitting.
- Secure easements and right of ways, acquisition parcels that have been identified as critical to the overall success of the flood conveyance; and channel modifications and revegetation to support those new flows and improve habitat.
- Establish a creek-wide O&M plan for weed management and to maintain the easements encroachment free will be instituted.

Relation to SPFC Facilities – Putah Diversion Dam

Project Status: Unknown

Applicable Management Action(s): Floodplain Management - Floodproofing

Contribution to CVFPP Goals:

- **Primary Goal –** Improve Flood Risk Management
- **Supporting Goals –** Improve Operations and Maintenance, Promote Ecosystem Functions, Promote Multi-Benefit Projects

Extent of Benefit Area: Project would have local and regional benefits.

Potential to Provide Multi-Benefits:

- **Flood Damage Reduction Benefit** – Protection and reduction of flood risk to Putah Diversion Dam and Putah Creek Road from failure –
    - Putah Diversion Dam 1 in 25 years to 1 in 100 years and Putah Creek Road from 1 in 10 years to 1 in 200 years
    - Restore channel capacity back to 34,000 cfs
    - Lower water surface elevations and reduce flow velocities by eliminating constrictions
- **Ecosystem Restoration**
    - Links the Interior Coast Range to the Yolo Wildlife Area and will benefit wildlife migration by controlling invasive weeds that block access to the floodplains

- Enhances riparian habitat that benefits 232 species of birds
- Converts a gravel pit to floodplain and wetlands to cool the temperature for 3 miles downstream
- Enhances wildlife viewing on adjacent City of Winters lands

- **Water Supply –** None
- **Recreation and Other Benefits –** Conserve orchards and row crops

Implementation Cost: $6,061,858

Implementation Considerations:

- **Redirected Hydraulic Impacts –** To Be Determined
- **Adverse Environmental Impact and Regulatory Issues –** Flood management actions, especially structural management actions, have the potential to adversely impact the environment while meeting other flood management goals. The impacts of this project have not yet been determined.
- **Other**

Associated Studies

U.S. Army Corps of Engineers (USACE). Habitat Improvement for Native Fish in the Yolo Bypass. December 2002.

References

Central Valley Non-Structural Grant Program Project Summary

1.52 Floodplain Expansion and Ecosystem Restoration at Dos Rios Ranch

Project Type: Floodplain Management

Location Information:

- **Region** – Lower San Joaquin
- **Subregion** – Tuolumne/ San Joaquin
- **Location** – Stanislaus County; Lower Tuolumne River Parkway; confluence of Tuolumne and San Joaquin rivers
- **Community Setting** – Nonurban

Project Proponents:

- **Potential Lead Non-Federal Agency** – River Partners
- **Potential Lead Federal Agency** – To Be Determined
- **Potential Partners** – Tuolumne River Trust and USDA NRCS
- **Contact Information** – Julie Rentner, River Partners

Description:

- **Purpose** – Floodplain reconnection and floodplain habitat restoration.
- **Concept** – Phase 2 of a current Flood Control Plan project which acquired the property. This phase will comprise of three major components; restoration planning and permitting, habitat restoration, and a levee breaching study. The project will restore flooding and transient floodwater storage to 948 acres of historic floodplain, restore riparian habitats, and promote river physical processes of scour and deposition along 6 river miles.
- **Relation to SPFC Facilities** – None

Project Status: Phase 1 of the project acquired the flood easement and Phase 2 is in planning.

Applicable Management Action(s): Floodplain Management – Easement/Acquisitions

Contribution to CVFPP Goals:

- **Primary Goal –** Improve Flood Risk Management
- **Supporting Goals –** Improve O&M, Promote Ecosystem Functions

Extent of Benefit Area: Project would have local and regional benefits.

Potential to Provide Multi-Benefits:

- **Flood Damage Reduction Benefit –** The flood benefit was obtained through Phase 1 of the project that included the acquisition of the property. Phase 2 is for restoration of the project plus a levee breaching study. If Phases 1 and 2 are considered one project, the flood benefits include the creation of 5,000 to 10,000 acre-feet of transient storage.
- **Ecosystem Restoration –** Improve the quality of the existing habitat linkages and migratory corridors in the region by restoring the biological processes of floodplain ecology to support avian, aquatic, and terrestrial-obligate species.
- **Water Supply –** Currently has groundwater storage and sediment trapping.
- **Recreation and Other Benefits**

Implementation Cost: $8,519,316

Implementation Considerations:

- **Redirected Hydraulic Impacts –** None anticipated.
- **Adverse Environmental Impact and Regulatory Issues –** None anticipated.

Associated Studies

None

References

Tuolumne River Preservation Trust. Project Information for the Tuolumne River Preservation Trust. 2005 Proposal Number: 0056. Available: < https://nrmsecure.dfg.ca.gov/FileHandler.ashx?DocumentVersionID=11007>

1.53 Elk Slough Area and Habitat Improvement Project

Project Type: System Modifications

Location Information:

- **Region** – Lower Sacramento
- **Subregion** – Sacramento
- **Location –** The site is adjacent to the town of Clarksburg, across the river from Elk Grove and Sacramento
- **Community Setting** – Nonurban

Project Proponents:

- **Potential Lead Non-Federal Agency** – DWR
- **Potential Lead Federal Agency** – USACE
- **Potential Partners** – DFG
- **Contact Information –** Bob Webber (DWR)

Description:

- **Purpose –** There is a backwater effect from flooding of the Sacramento River and the area is in direct risk of flooding from the Sacramento River as well. There is a risk of levee breaches from other areas such as from West Sacramento levee failures. The area is at risk of development, and encroachment on levees is common. Also, the highest terrain consists of the levees, which puts the area at risk.

- **Concept –** The Elk Slough Area Flood and Habitat Improvements Project proposes to improve flood protection for a rural Delta community and valuable agricultural land, improving much-needed riparian and aquatic habitat, while at the same time reconnecting an important anadromous fish passage.

  The project proposes constructing a new headgate structure to establish a flood protection corridor, and to relocate or floodproof existing structures necessary for the establishment of this corridor.

- Relation to SPFC Facilities – None

Project Status: Unknown

Applicable Management Action(s): System Modifications – Closure Structures

Contribution to CVFPP Goals:

- **Primary Goal –** Improve Flood Risk Management
- **Supporting Goals –** Promote Ecosystem Functions, Improve Institutional Support

Extent of Benefit Area: Project would have local benefits

Potential to Provide Multi-Benefits:

- **Flood Damage Reduction Benefit**
  - This project will reduce flood risk from approximately 19 miles of at risk levees, 1,401 people (2000 Census), 38,479 acres, and $70 million of annual agricultural value, through the establishment of easements and the relocation or minor modification of existing structures.
  - A conservative estimate would be a 10 percent improvement in local flood water conveyance for an overall area of approximately 38,479 acres, which would reduce frequency of flooding and lower stage height. The precise improvements would be determined through this project, as there is no Base Flood Elevation for RD-999. Approximately 4,300 acres of the properties immediately surrounding Elk Slough would have a reduction of stage primarily, as flow would be improved around the slough.
  - The project is intended to improve flowage through the district’s drain system and around Elk Slough.
- **Ecosystem Restoration**
  - Project proposes to establish a anadromous fish passage
  - Improve aquatic habitat such as shaded riverine aquatic, scrub-shrub, and riparian forest.

- Improve water quality by laying back the banks of the slough to support native vegetation and improve flood conveyance
- Improve native fish species diversity
- Improve habitat through weed removal

- **Water Supply –** None
- **Recreation and Other Benefits –** Conserve agricultural land (local vineyards and row crops) through agricultural conservation.

Implementation Cost: $3,042,250

Implementation Considerations:

- **Redirected Hydraulic Impacts –** To Be Determined
- **Adverse Environmental Impact and Regulatory Issues –** Flood management actions, especially structural management actions, have the potential to adversely impact the environment while meeting other flood management goals. The potential impacts of this project have not yet been determined.

Associated Studies

None

References

Central Valley Non-Structural Grant Project Information

1.54 Sutter Basin Flood Corridor Conservation Project

Project Type: Floodplain Management

Location Information:

- **Region** – Lower Sacramento
- **Subregion –** Feather River/Yuba River
- **Location –** Sutter County. Located east of the town of Robbins. Between Armour Road and the west levee of Sutter Bypass near the confluence with the Feather River, and between Kirkville and Maddock roads.
- **Community Setting** – Nonurban

Project Proponents:

- **Potential Lead Non-Federal Agency –** Ducks Unlimited, Western Regional Office
- **Potential Lead Federal Agency –** U.S. Department of Agriculture
- **Potential Partners** –, Montna Farms
- **Contact Information –** Joe Navari (Ducks Unlimited)

Description:

- **Purpose –** The Sutter Basin, located on west side of Sutter Bypass, has historically been an overflow area for both Sacramento and Feather rivers. Substantial efforts to manage the Sacramento and Feather river floodwaters has resulted in the Sutter Basin being completely surrounded by levees and will remain dry unless levees fail. The subject property has flooded in past due to seepage from western levee of Sutter Bypass and during large flood events due to levee failure.
- **Concept –** The project would place a conservation easement on 2103 acres of agricultural lands. The easement would protect the agricultural productivity, soils, the associated wildlife values and the future of arming in the Sutter Basin. The conservation easement would restrict subdivision and would also provide foraging habitat for wintering migratory birds.

- **Relation to SPFC Facilities –** None

Project Status: Unknown

Applicable Management Action(s): Floodplain Management – Easements/Acquisitions

Contribution to CVFPP Goals:

- **Primary Goal –** Improve Flood Risk Management
- **Supporting Goals –** Promote Ecosystem Functions

Extent of Benefit Area: Project has local and regional

Potential to Provide Multi-Benefits:

- **Flood Damage Reduction Benefit –** Project would place an agricultural conservation easement on 2,103 acres and limit development to outside the project area. Project would protect areas downstream by providing flood capacity to the Sutter Bypass levee during large levee failure and heavy flow events.
- **Ecosystem Restoration –** Project would provide foraging habitat for wintering migratory birds.
- **Water Supply –** None
- **Recreation and Other Benefits –** Project would place an agricultural conservation easement on 2013 acres. Present agricultural use is intensive rice production and produces 80 to 90 100-pound sacks of rice per acre.

Implementation Cost: $6,431,710

Implementation Considerations:

- **Redirected Hydraulic Impacts –** The project will not reduce the magnitude of a flood flow. The project will lower surface water elevations during a local flood event by keeping the property in low-intensive agriculture on flat land resulting in little or no flood damage. No impairments that would impact flow velocities from flooding because the property will allow low-flow inundation and the property is flat farmland.

- **Adverse Environmental Impact and Regulatory Issues –** No long-term adverse environmental impact.

- **Other**

Associated Studies

None

References

Central Valley Non-Structural Grant Project Information.

Ducks Unlimited, Inc. Flood Protection Corridor Program Project Evaluation Criteria and Competitive Grant Application Form. February 2003. Available: < http://www.water.ca.gov/floodmgmt/fpo/sgb/fpcp/prop13/proposals /3002_LealProperties/Application.pdf>

1.55 Colusa Ring Levee Flood Protection

Project Type: Local Area Protection

Location Information:

- **Region –** Upper Sacramento
- **Subregion –** Colusa Drain
- **Location –** Highway 20 just outside City of Colusa limits
- **Community Setting –** Other

Project Proponents:

- **Potential Lead Non-Federal Agency –** County of Colusa
- **Potential Lead Federal Agency –** USACE
- **Potential Partners –** To Be Determined
- **Contact Information –** Chris Ferrari, HDR

Description:

- **Purpose –** In 2000, Phase 1 of a ring levee project was constructed westward of the city limits between high ground to the north and Highway 20, which runs east-west. This included the construction of a new levee along the Colusa Basin Drain to impede floodwater coming from the northeast that historically inundated the project area. After construction of the Phase 1 levee, flooding still occurred from floodwater backing up from the south across Highway 20 and inundating portions of the project area. There is also an existing federal project levee to the south of the city limits approximately 2.1 miles south east of the Phase 1 levee.

  Historically flooding has occurred when flood waters flowing in the Colusa Basin Drain spread near the Highway 20 Bridge and extended northeast. Flooding was experienced to an approximate depth of 2.5 feet during high-water events in 1995, 1997, and 1998. In some of these instances, Highway 20, the areas major thoroughfare, was shut down due to flooding. Though these events occurred before the construction of the Phase 1 levee, the area has not experienced similar events to test the new levee system. In addition, since the Phase 1 levee has not been certified, it is not recognized as having a flood damage reduction benefit to the project area.

- **Concept –** Project would construct a 2.9-mile ring levee to connect to the Phase 1 and federal project levees to provide flood damage reduction from the Colusa Basin Drain, which generally runs north-south to the west of the project area.

- **Relation to SPFC Facilities –** Colusa Basin Drain

Project Status: Phase 1 is complete. Further design and construction are necessary.

Applicable Management Action(s): System Modifications – Levees/Floodwalls/Hydraulic Structures

Contribution to CVFPP Goals:

- **Primary Goal –** Improve Flood Risk Management

- **Supporting Goals –** Improve O&M, Promote Ecosystem Functions, Improve Institutional Support, Promote Multi-Benefit Projects

Extent of Benefit Area: Project would have local, regional, and systemwide benefits.

Potential to Provide Multi-Benefits:

- **Flood Damage Reduction Benefit –** Once certified, the new levee system would effectively cut off flooding associated with the Colusa Basin Drain from the west, removing approximately 2,600 acres out of the floodplain. In a flood event, floodwaters extend into the unincorporated areas of Colusa County, that area directly adjacent to the City of Colusa, inundating agricultural and commercial land. This impacts approximately 110 structures, State Highway 20, and several acres of agricultural land. The total estimated value of the structures impacted by the floodwater is $26.1 million.

- **Ecosystem Restoration –** Implementation of the project includes restoration of a 27-acre borrow site that will be owned by the City of Colusa and will provide habitat connectivity to the adjacent existing Phase 1 borrow site. The Phase 1 borrow site, currently composed of wetland/pond habitat, will be expanded to provide borrow for the proposed project. The land proposed for the borrow site is currently in agricultural production. Soil will be removed from the borrow site for use during construction. Upon completion of construction, wetland and pond habitat similar to that created at Phase 1 site will be created at the borrow site.

Areas of unique ecological and biological diversity in and adjacent to the site include vernal pools, seasonal and managed wetlands, alkali grassland, riparian habitats and drainages. Agricultural fields provide foraging habitat for migrating waterfowl along the Pacific Flyway as well as resident and migratory raptors and waterfowl. The site is located adjacent to the 646-acre Colusa National Wildlife Refuge North Central Valley Wildlife Management Area.

- **Water Supply –** None
- **Recreation and Other Benefits –** None

Implementation Cost: $5.5 million

Implementation Considerations:

- **Redirected Hydraulic Impacts –** To Be Determined
- **Adverse Environmental Impact and Regulatory Issues –** Flood management actions, especially structural management actions, have the potential to adversely impact the environment while meeting other flood management goals. The potential impacts of this project have not yet been detrmined.
- **Other**

Associated Studies

None

References

Central Valley Non-Structural Grant Project Information

1.56 The Lower San Joaquin River Flood Bypass

Project Type: System Modifications

Location Information:

- **Region –** Lower San Joaquin
- **Subregion –** San Joaquin County, Stockton and South Delta
- **Location –** In the Delta, along Paradise Cut/San Joaquin River, south of Stewart Tract, west of cities of Lathrop and Manteca; at juncture of Interstates 5 and 205
- **Community Setting –** Urban

Project Proponents:

- **Potential Lead Non-Federal Agency –** Southern Delta Levee Protection and Channel Maintenance Authority
- **Potential Lead Federal Agency –** To Be Determined
- **Potential Partners –** South Delta Water Agency and Reclamation District 2062, American Rivers and Natural Resources Defense Council, River Islands Development Company, San Joaquin County Resource Conservation District, University of the Pacific, American Lands Conservancy
- **Contact Information –** John Brodie (Mokelumne River Watershed Coordinator, San Joaquin County RCD)

Description:

- **Purpose:**
  - High flood stage on San Joaquin River between Mossdale and Stockton
  - High probability of catastrophic flooding in Lathrop, Manteca, Stockton, and unincorporated San Joaquin County
  - Loss of sensitive species habitat
  - Loss of farmland to development

  - Uncontrolled flooding on farmland

- **Concept:**

  - Increase flood conveyance capacity through a constrained reach of the San Joaquin River floodway by acquiring easements and fee title to expand Paradise Cut Bypass.

  - Provide floodplain and riparian habitat for sensitive species including riparian brush rabbit, giant garter snake, Sacramento splittail (*Pogonichthys macrolepidotus*), and juvenile Chinook salmon.

  - Preserve agricultural land and protect it from uncontrolled flooding.

- **Relation to SPFC Facilities – Paradise Cut Bypass**

Project Status: Recon or Feasibility Phase

Applicable Management Action(s): System Modifications – Increase Bypasses Capacity

Contribution to CVFPP Goals:

- **Primary Goal –** Improve Flood Risk Management

- **Supporting Goals –** Promote Ecosystem Functions, Improve Institutional Support, Promote Multi-Benefit Projects

Extent of Benefit Area: Project would have local, regional, and systemwide benefits

Potential to Provide Multi-Benefits:

- Fl**ood Damage Reduction Benefit**

  - "The bypass would open up the most significant flood conveyance bottleneck in the San Joaquin Valley and potentially the state of California – a bottle neck that has implications for both public safety and water supply." (from application)

  - Reduced flood stage in mainstem San Joaquin River between Vernalis and Stockton.

    Reduced likelihood of levee failure on San Joaquin River in Lathrup, Manteca, and Stockton areas.

- **Ecosystem Restoration**
  - **Sensitive species and habitat** - Swainson's hawk, valley elderberry longhorn beetle, tricolored blackbird (*Agelaius tricolor*), bats, burrowing owl (*Athene cunicularia*), northern harrier (*Circus cyaneus*), riparian brush rabbit (*Sylvilagus bachmani riparius*), giant garter snake, Swainson's hawk, steelhead salmon, fall-run Chinook and spring-run salmon, Sacramento splittail, others.
  - Riparian corridor along Paradise Cut, a significant riparian corridor connecting the Delta to the lower San Joaquin River and has been identified as a significant natural resource area in the San Joaquin County Conservation Plan.
  - *Benefits* **–** Up to about 100 acres habitat, 950 acres flood and habitat, and 921 acre flood, agriculture, and habitat.
- **Water Supply –** Increase Bypass capacity and flood flow through the South Delta region would potentially decrease the salinity level in the Delta region and improve the water quality of the regional water supply.
- **Recreation and Other Benefits**
  - *Benefits* **–** Change of about 4,221 acres of existing agriculture into approximately 2,200 acres of flood and agriculture, and 921 acres of flood and agriculture and habitat.
  - Development avoided by use of flood easements, conservation easements, fee title acquisition, and possibly use Williamson Act contracts.
  - Inundation to some lands controlled by flood easements on others.
  - Flexibility for changes in upstream reservoir management to better optimize the water supply and flood control purposes of four major upstream reservoirs.
  - Wetland creation along the expanded bypass corridor could have significant water quality benefits, including sediment settling out of the water column into the bypass area.
  - While local access may or may not become available, public viewing may be available from developing River Islands development project to the north.

Implementation Cost: $6,125,000

Implementation Considerations:

- **Redirected Hydraulic Impacts –** To Be Determined
- **Adverse Environmental Impact and Regulatory Issues –** Flood management actions, especially structural management actions, have the potential to adversely impact the environment while meeting other flood management goals. The potential impacts of this project have not yet been determined.
- Other

Associated Studies

BDCP EIR/EIS

References

Central Valley Non-Structural Grant Project Information.

BDCP EIR/EIS

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Department of Water Resources
The California Natural Resources Agency
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