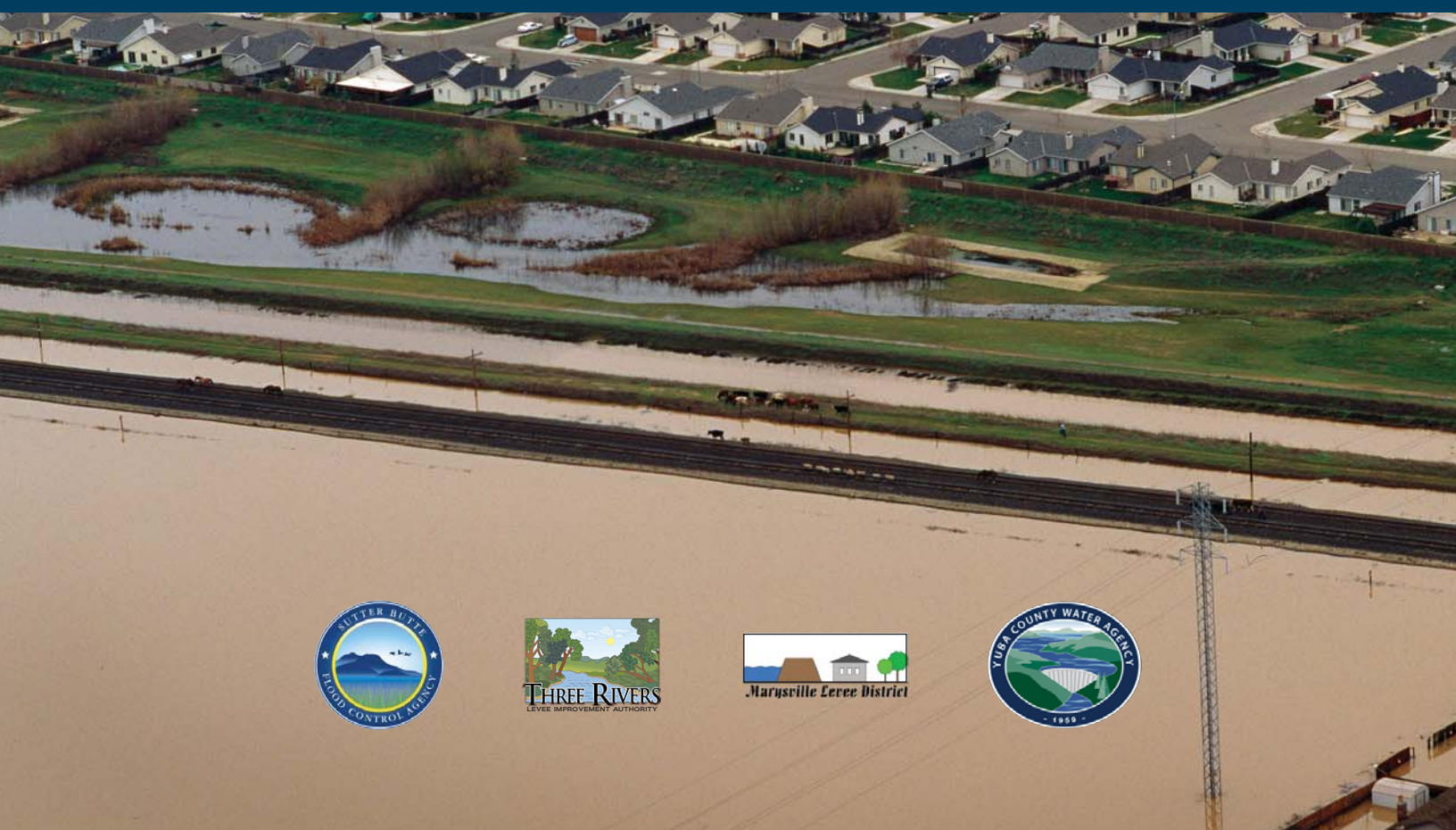


DRAFT FINAL

July 2014

Feather River Region Regional Flood Management Plan

Funded by the California Department of Water Resources



**Feather River Region
Administrative Draft
Regional Flood Management
Plan**

Draft Final, July 2014

Funded by the California Department of Water
Resources

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Acronyms and Abbreviations

Acre-Feet (AF)	Division of Flood Management (DFM)
Alternative Licensing Process (ALP)	Downstream (D/S)
Assistant Secretary of the Army (ASA)	Draft Urban Level of Flood Protection Criteria (ULOP, April 2012)
Basin-Wide Feasibility Studies (BWFS)	DWR Flood Operations Center (FOC)
California Air Resources Board (ARB)	DWR Flood System Repairs Program (FSRP)
California Debris Commission (CDC)	DWR's Division of Operation and Maintenance (O&M)
California Department of Conservation (DOC)	Emergency Operations Center (EOC)
California Department of Fish and Wildlife (CDFW)	Emergency Spillway Release Diagram (ESRD)
California Department of Water Resources (DWR)	Engineering Documentation Report (EDR)
California Nevada River Forecast Center (CNRFC)	Engineering Manual (EM)
California Office of Emergency Services (Cal OES)	Enhanced Flood System Operations and Maintenance (EFSOM)
California Regional Water Quality Control Board, Central Valley Region (CRWQCB)	Expected Annual Damage (EAD)
California Surface Mining and Reclamation Act (SMARA)	Farmland Security Zone (FSZ)
Central Valley Flood Protection Board (Board or CVFPB)	Feather River Regional Flood Management Plan (RFMP)
Central Valley Flood Protection Plan (CVFPP)	Federal Emergency Management Agency (FEMA)
Central Valley Floodplain Evaluation and Delineation Program (CVFED)	Federal Energy Regulatory Commission (FERC)
Central Valley Hydrology Study (CVHS)	Feet (FT)
Corridor Management Plans (CMP)	Flood Control Diagram (FCD)
Cubic Feet per Second (CFS)	Flood Insurance Rate Maps (FIRM)
Deep Soil Mixing (DSM)	FloodSAFE California (FloodSAFE)
	Forecast-Based Operations (FBO)
	Forecast-Coordinated Operations (FCO)

Forecast-Coordinated Operations (F-CO)	North American Vertical Datum of 1988 [NAVD88]
Geotechnical Assessment Report (GAR)	Not applicable (NA)
Geotechnical Design Recommendations Report (GDRR)	Operation, Maintenance, Repair, and Rehabilitation (OMRR)
Giant Garter Snake (GGS)	Operational Areas(OA)
Hazard Mitigation Grant Programs (HMGP)	operations and maintenance (O&M)
Hazard Mitigation Plan (HMP)	Oroville Wildlife Area (OWA)
HEC-FDA = Hydrologic Engineering Center Flood Damage Analysis	Pre-Disaster Mitigation (PDM)
Integrated Regional Water Management Plan (IRWMP)	Procedure Memorandum 34 (PM 34)
Lands, Easements, Real Estate, Relocations (LERRDs)	Project Partnership Agreement (PPA)
Levee Maintaining Agency (LMAs)	Provisionally Accredited Levee (PAL)
Levee Miles (LM)	Provisionally Accredited Levees (PALs)
Locally Preferred Plan (LPP)	Public Law 84-99 (PL 84-99)
Lower Feather River Channel (LFRC)	Reclamation District 784 (RD 784)
Lower Feather River Corridor Management Plan (LFRCMP)	reclamation districts (RD)
Maintenance Areas (MAs)	Regional Flood Management Plan (“RFMP” or “Plan”)
Marysville Levee Commission (MLC)	Rehabilitation and Inspection Program (RIP)
Memorandum of Understanding (MOU)	Risk and Uncertainty (R and U)
Most Likely Descendants (MLDs)	River Mile (RM)
National Economic Development (NED)	Rural Levee Repair Criteria (RLRC)
National Flood Insurance Program (NFIP)	Sacramento Area Flood Control Agency (SAFCA)
National Geodetic Vertical Datum of 1929 (NGVD 29)	Sacramento River Flood Control Project (SRFCP)
National Incident Management System (NIMS)	Sacramento-San Joaquin Delta (Delta)
National Ocean and Atmospheric Administration (NOAA)	Special Flood Hazard Area (SFHA)
National Weather Service (NWS)	Special Flood Hazard Areas (SFHA)
Non-Governmental Organization (NGO),	Standardized Emergency Management System (SEMS)
Non-Urban Levee Evaluation (NULE)	Standardized Emergency Management System (SEMS)
	State Historic Preservation Office (SHPO)
	State Plan of Flood Control (SPFC)

State Water Project (SWP)
State Water Resources Control Board
(SWRCB)
State Water Resources Control Board's
(SWRCB)
Supplemental Geotechnical Data Report
(SGDR)
Sutter Butte Flood Control Agency
(SBFCA)
Tentatively Selected Plan (TSP)
Three Rivers Levee Improvement Authority
(TRLIA)

Union Pacific Interceptor Canal (UPIC)
Urban Levee Design Criteria (ULDC, April
2012)
Urban Levee Evaluation (ULE)
URS (URS Corporation)
USFWS Habitat Evaluation Procedure
(HEP)
Western Pacific Interceptor Canal (WPIC)
Western Pacific Railroad (WPRR)
Yuba County Water Agency (YCWA)
Yuba Goldfields (Goldfields)

Executive Summary

Purpose of Report

The Yuba County Water Agency (YCWA), Three Rivers Levee Improvement Authority (TRLIA), Marysville Levee Commission (MLC), and Sutter Butte Flood Control Agency (SBFCA) have partnered with the State of California Department of Water Resources (DWR) to develop this Feather River Regional Flood Management Plan (“RFMP” or “Plan”). This Plan reflects the flood management priorities of the Feather River Region while at the same time aligning with the recently adopted 2012 Central Valley Flood Protection Plan (CVFPP) to the extent feasible. By clearly establishing regional flood management priorities, this Plan will facilitate future funding and implementation of much-needed flood risk reduction projects.

Although funded by DWR, the intent of all five partnering agencies (YCWA, TRLIA, MLC, SBFCA, and DWR) is to facilitate the development of a broadly supported Plan and embrace the FloodSAFE vision. This Plan is being shaped by the concerns and priorities of the communities in the Feather River Basin, including local Levee Maintaining Agencies (LMAs) representatives, elected officials, property owners, businesses, interested individuals, small community representatives, native tribes, and non-governmental organizations. Accordingly, the planning process is founded on a strong strategic stakeholder outreach effort. Concurrent goals of the outreach effort are to strengthen inter-agency working relationships, engender region-wide understanding of integrated flood management goals, objectives, and needs, and promote a sustainable partnership structure to facilitate future implementation of mutually-beneficial projects.

A diverse range of stakeholders, often with divergent interests and opinions, participated in this process. While all of these interests and opinions were carefully considered, it is ultimately the responsibility of the four local partnering agencies to formulate the perspective and recommendations of the region as documented in this report. For simplicity, these are attributed to “the region” throughout this report.

The Planning Process

The plan formulation tasks focus on developing a description of the current state of flood management within the region, identifying opportunities for improving flood management while achieving multiple objectives, setting priorities, and developing a financing plan. Together, these plan elements will define the long-term vision for flood risk reduction in the region.

The approach has involved a structured public outreach process, supported by available engineering, environmental, and financial analyses, leading to the incremental formulation of the RFMP. A website (<http://frfmp.com/>) and hotline ((530) 845-5988) were established in March 2013 to provide ready access to the planning team and the evolving documents compiled in the course of the planning process. The schedule of activities, meeting notices and summaries, briefing materials, the draft and final report, and supporting documents have been posted on the website as they become available. In addition, the website includes links to key agencies and

other planning processes. These materials are also distributed via email to all interested parties. A link to register as an interested party is available under the “Contact” link on the website.

Comments on the October 4, 2013 Draft Report and Responses

Following release of the October 4, 2013 draft report and a public workshop held in Marysville on November 13, 2013 the planning team has received comment letters and met with numerous stakeholders to learn about their perspectives on the issues and proposed plan described in the report. This revised draft report reflects the planning team and Steering Committee’s careful consideration of the feedback provided over the past seven months. The major comments and responses are briefly summarized here. Additional detail is provided in a table of specific comments and responses posted on the project website (<http://frrfmp.com/>). The original comment letters are also posted.

In general, the National Marine Fisheries Service, River Partners, the National Wildlife Service and the California Department of Fish and Wildlife suggested that the draft plan fell short of the environmental restoration and multi-objective goals of the CVFPP. They urged the region to commit to implementing multi-objective projects, including new levee setbacks, restoration of natural riverine processes, and enhancing fish and wildlife habitats.

On the other hand, representatives of the agricultural community, including the California Farm Bureau and the Yuba-Sutter Farm Bureau emphasized the importance of protecting productive farmland, recognizing and optimizing the wildlife habitat values of existing farmland, and maintaining the existing floodways through vegetation and sediment removal to restore design capacities.

During the draft review period these groups met in two highly productive meetings to develop a mutual understanding of their respective interests and concerns. Among the key areas of agreement which emerged in these meetings was the recognition that there are tremendous opportunities for restoration and environmental enhancement and flood risk reduction within the existing floodways of the lower Feather River, Yuba River, and Bear River that can be achieved through removal and re-grading of hydraulic mining debris which remain as a legacy of the gold mining era. With removal and re-grading of terraced hydraulic mining debris, consisting of sand, gravel, and cobbles, it is feasible to enhance riparian vegetation, SRA habitat and other ecological benefits while still achieving a net increase in hydraulic conveyance capacity. When such excavated material is beneficially re-used for other purposes, such restoration activities become much more financially feasible.

The planning team and the Steering Committee carefully considered the resources agencies’ recommendation to put greater emphasis in the Plan on environmental restoration and multi-objective planning. This draft has been revised to reflect its concurrence with the fundamental importance of achieving those goals. It emphasizes that the region has been a pioneer in multi-objective project implementation, in partnership with State and federal agencies and NGOs over more than a decade. Among the notable regional achievements are:

- Wild River status for the South Yuba River in 1999, emerging from an extraordinary process of negotiation, public outreach and legislation.
- Yuba-Feather Program, included in Proposition 13 (2000) and subsequent implementation of levee setbacks on the Bear River and Feather River by TRLIA, which added over 2,200 acres to the floodway, now essentially complete. TRLIA has been, and

continues to be extraordinarily proactive with regard to floodway environmental restoration planning and implementation.

- Lower Yuba River Accord, executed in 2008, which improves fisheries habitat, water supply, and power benefits provided by the Yuba River system.
- Star Bend Levee Setback, constructed in 2009, which significantly improved public safety, expanded the Lower Feather River floodway, and provided opportunities for environmental enhancement.
- Collaboration with State and federal agencies on the DWR-led Lower Feather River Corridor Management Plan, now in administrative draft form and soon to be made available for public review.
- Feather River West Levee Program, now underway, includes commitments to implement multi-objective features, including habitat restoration within the floodway, recreational enhancements, and other features.

This plan builds on that legacy of enlightened, multi-objective project implementation. However the planning team and Steering Committee believe that it is not feasible or reasonable to make commitments regarding the way multi-objective features will be bundled in future projects. Those specifics will emerge at the project planning and implementation level, when integration opportunities, cost sharing opportunities, and financing capabilities are fully understood. Therefore this plan provides a description of the various management actions in Chapters 6, 7, 8, and 9, which can be combined during implementation to advance the regional goals and objectives. A description of the environmental setting has been added to Chapter 2 and Chapter 6 has been re-written to add more specificity to the suite of actions that can advance agricultural and environmental stewardship.

One person noted that the Plan did not adequately address the need for public access and recreational features in the regional floodways. In response the planning team drafted a new Chapter 7 which describes recreational assets, issues, and opportunities.

LMAs, including DWR acting in its capacity as maintaining agency, provided additional detail regarding the growing constraints, challenges, and expenses they face while working to meet federal and State project maintenance mandates. The Central Valley Flood Control Association's Rural Levee Workgroup has prepared a series of topic papers describing issues and concerns related to rural levee maintenance in the Central Valley. The papers were released in December 2013. The Association informally requested that the RFMP consider these papers while formulating the Feather RFMP. The draft report has been augmented to reflect all of this input.

Project proponents have provided helpful feedback, leading to refinement of the flood risk reduction projects described in Chapter 8 which are in various stages of planning, design, and execution. Table 10-1, which summarizes all of the major management actions included in the Plan, has been revised as well.

Stakeholders interested in, and affected by, the Cherokee Canal expressed frustration with the current status of maintenance of the project, as well as opposition to creation of a Feather River Bypass. The strong local preference is for more aggressive maintenance of the existing project and potential modification of the project to include one or more sedimentation basins at the

upper end of the project, a flood relief weir on the south side of the project, a floodway corridor management plan to address sediment and vegetation, a recognition of the great habitat value provided by adjoining rice cropland, and a request to update FEMA mapping of the affected floodplain. The discussion of Cherokee Canal throughout the report, in Chapters 4, 6, and 8, has been revised to incorporate this input.

Some comments noted the absence of a substantial Financial Plan in the October 4 draft. The placeholder text in the October 4 draft has been replaced with Chapter 11, which provides a regional financial profile, describes potential funding opportunities, and provides a detailed financial profile for each of the planning sub-areas in the region.

Comments on the May 19, 2014 Draft Report and Responses

The May 19, 2014 revised draft report was made available for public review on the Feather RFMP website on May 22, 2014. A public meeting in Yuba City on June 4 provided an opportunity for interested stakeholders to hear a summary of the report and changes made since the October 4 draft.

Public comments and discussion at the meeting focused primarily on concerns about the Plan proposing new restrictions upon public access to the river corridors of the region, as well as the impacts on LMAs and property owners of unrestricted access. Stakeholders followed up with numerous emails commenting on these concerns. Chapter 7 of this draft final report has been revised in response to these comments to provide a more complete and balanced discussion of the public access issue.

Comment letters and emails were also submitted by RD 784, YCWA, Yuba-Sutter Farm Bureau, River Partners, and a property owner with an interest in Cherokee Canal. In general, these letters provided helpful corrections and suggestions, many of which were incorporated into the revised draft report. CDFW indicated that it intends to provide further comments, which will be submitted in the mid-July timeframe.

This draft final report reflects the status of the Feather RFMP at the end of Phase 1 of the planning process. It is anticipated that Phase II of the process, which begins July 1, 2014, will lead to further stakeholder discussions and refinement of the Plan.

The planning team and Steering Committee are grateful for the thoughtful feedback and active involvement of all those who have participated in the process leading to the completion of this revised draft report.

Relationship with the Central Valley Flood Protection Plan

The CVFPP is a critical document to guide California's participation (and influence federal and local participation) in managing flood risk along the Sacramento River and San Joaquin River systems. The CVFPP proposes a system-wide investment approach for sustainable, integrated flood management in areas currently protected by facilities of the State Plan of Flood Control (SPFC). The CVFPP will be updated every five years, with each update providing support for subsequent policy, program, and project implementation.

DWR conducted planning and investigations for the 2012 CVFPP from 2009 through 2011, representing the most comprehensive flood evaluations for the Central Valley ever conducted by the State. The CVFPP was adopted by the Central Valley Flood Protection Board (Board or CVFPB) on June 29, 2012. During the review and adoption process regional representatives

expressed support for the goals and objectives set for the CVFPP, as well as concerns about the potential expansion of the Sutter Bypass and creation of a new Feather River Bypass. The CVFPP responded to these concerns in its adoption resolution, 2012-25, including deletion of the Feather River Bypass from the CVFPP.

Given its vast scope, the CVFPP could not incorporate the level of detail needed to specifically delineate likely system-wide improvement alternatives, nor did it include a detailed discussion of local flood risk reduction priorities. Instead, it provides a broad vision to help guide regional- and State-level financing plans to guide investments which may be in the range of \$14 billion to \$17 billion over the next 20 to 25 years.

In order to bring that process to fruition with the necessary level of detail and opportunity for full local participation in the planning process, the 2017 update to the CVFPP will be informed by regional flood management plans, such as this one, two basin-wide feasibility studies, and the Conservation Strategy. The Conservation Strategy expands upon the Conservation Framework that was included in the 2012 CVFPP.

The regional planning effort has been subdivided into regions (Figure 1-2). At the request of the involved regional agencies, several of the original nine regions were consolidated into six. The regional plans are intended to clearly define local and regional flood management needs, priorities, and financing capabilities.

The two Basin-Wide Feasibility Studies (BWFS) will cover the Sacramento River Basin and the San Joaquin River Basin, respectively. They will primarily focus on the long-term needs of the SPFC to provide trans-regional benefits and improvements to the capacity, flexibility, and resiliency of the Central Valley Flood Management system.

DWR has indicated that it will prioritize State cost share funding for elements of the regional flood management plans to the extent that these elements are compatible with the vision, guiding principles, and elements of the CVFPP. DWR will likely also consider the availability of limited State funding and indices of effectiveness, such as net benefits, benefit to cost ratios, and other measures when prioritizing the allocation of State funds.

The Feather River Regional Flood Management Plan formulation process is an integral part of the CVFPP process. It provides an opportunity for the region to bring into focus flood management issues of local concern, devise solution options, set priorities, and explore local financing mechanisms to help pay for planning, design, construction, and operation and maintenance. It also provides an opportunity for the region to offer recommendations to DWR in support of the SSIA refinement process. This effort, while coordinated with the larger CVFPP, will build on the successes of projects implemented in the region since the 1986 flood, and to obtain State and federal cost sharing to the maximum extent feasible.

It is especially important that the region expedite the planning process to take advantage of remaining Proposition 1E (Disaster Preparedness and Flood Prevention Bond Act of 2006) and Proposition 84 (The Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Bond Act of 2006) bond funds, which were authorized in 2006, but expire if not committed by the end of 2016. It is anticipated that compatible portions of the evolving Feather River Regional Flood Management Plan (RFMP) will be incorporated into the Sacramento Valley BWFS and the CVFPP, which will facilitate future State and federal cost sharing contributions to these elements.

Consistent with the input provided to the CVFPB during the CVFPP adoption process, the region remains concerned about the potential loss of agricultural lands and resultant economic impacts (Hamilton and O'Brien, 2013), redirected hydraulic impacts, and public expense associated with the implementation of the Sutter Bypass expansion and the creation of a new Feather River Bypass. While the Feather River Bypass does have the potential to reduce the flood risk of the urban communities in our region, the impacts and costs do not appear to justify further consideration of this alternative. If the BWFS is going to evaluate measures to reduce the flood risk beyond the 200 year level that will be accomplished by the urban levee improvements currently underway, consideration should also be given to evaluating new or expanded reservoirs as alternatives to the Feather River Bypass and widening of the Sutter Bypass to achieve the goals of providing resiliency, adaptability to climate change and integrated water management.

Regional Goals and Objectives

The regional goals and objectives are to improve flood risk management in the region while advancing the supporting goals of improving operations and maintenance, promoting ecosystem functions, improving institutional support, and promoting multiobjective projects. These objectives of the regional planning process are founded on, and consistent with, the goals of the CVFPP as described in the 2012 Plan. These goals and objectives are intended to address the specific public safety, environmental quality, and economic health concerns of the region as described in Chapter 3 and 4 of this report. Specific objectives for the region have been formulated as well to reflect the history, culture, land use, and hydrology of the region. Chapter 5 describes the major solution strategies which have been used, and are proposed, to meet the goals and objectives of the region. Chapters 6, 7, 8, and 9 describe specific actions, which when combined, can create highly effective multi-objective projects which help achieve the region's goals and objectives.

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 operations and maintenance, 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 to the extent feasible.
- **Improve Institutional Support** – Develop stable institutional structures, coordination protocols, and financial frameworks that enable effective and adaptive integrated flood management (designs, operations and maintenance, 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.

These goals, described above, provide guidance for the formulation of its specific policies and physical elements. The goals also capture guidance and objectives provided in the authorizing legislation (California Water Code Section 9616) (DWR 2012). DWR also prepared the Conservation Framework which is an integral part of the SSIA identified in the 2012 CVFPP and describes how environmental stewardship is integrated to make progress towards meeting the environmental objectives of the Central Valley Flood Protection Act of 2008 throughout the flood management system. In April 2014, DWR completed an administrative review draft of the 2017 Conservation Strategy, which although unpublished, has been helpful in advancing the region’s effort of aligning proposed actions with DWR’s goals and objectives.

The goals of the RFMP are consistent with the broader goals of the CVFPP. The primary goal of the RFMP is to collaboratively improve flood risk management within the region, while improving operations and maintenance, promoting ecosystem functions, improving institutional support, and promoting multi-benefit projects. By aligning as closely as feasible with CVFPP goals the region seeks to maximize State and federal cost sharing and to execute high priority projects, consistent with the Regional Plan, as rapidly as feasible. Specific regional objectives include:

- **Urban and Urbanizing** - Provide 200-year flood protection for urban and urbanizing areas of the region, including Marysville, Yuba City, portions of Sutter, RD 784 and Wheatland.
- **Small Communities** - Provide 100-year flood protection for the small communities in the region, including Rio Oso and Nicolaus.
- **Rural Agricultural Areas** - Improve flood protection for the rural agricultural areas within the region.
- **Flood System Sustainability** - Improve the flexibility and sustainability of the regional flood management system in light of climate change and regulatory constraints by reducing the costs and increasing the effectiveness of levee maintaining agencies.
- **Agricultural Sustainability** - Support and strengthen the regional economy, primarily founded on highly productive farmland; achieve wildlife habitat objectives through preservation and/or modification of current agricultural practices to the extent feasible; and modify State and federal floodplain regulations to help sustain agricultural uses of regional floodplain.

- **Multiple Objectives** - Incorporate multiple objectives such as environmental restoration, agricultural enhancement, improved water quality, open space, energy production, and recreation, to the extent compatible with existing land uses and supported by affected landowners.
- **State Systemwide Investment Approach (SSIA) and Regional Projects** - Describe opportunities to link SSIA to regional projects and/or objectives. Accordingly, describe challenges of these linkages.

The proposed regional Plan will achieve these goals and objectives through both structural and non-structural means, as described in subsequent sections of this Plan.

While the regional goals and objectives are consistent with the CVFPP goals, the regional objectives place a greater emphasis on the preservation of economically productive agricultural land than does the CVFPP, for several reasons:

Agriculture provides the foundation for the regional economy. Loss of highly productive agricultural lands to accommodate larger flood conveyances, transient floodplain storage, and wildlife habitat could affect the long-term viability of the regional economy, including the many secondary and tertiary businesses which support agriculture.

There are many opportunities for improving the multi-objective benefits of productive agricultural land, (an example is benefit to habitats) which can concurrently strengthen the economic viability of agriculture in the region. The region seeks to take maximum advantage of these evolving opportunities while minimizing future land use conversion to wildlife and fisheries habitat.

There are also great opportunities for further environmental enhancement and restoration of ecological processes within the floodways of the Feather, Yuba, and Bear rivers, which can be implemented as part of multi-objective projects which also improve flood conveyance. For example, removing and re-grading terraced hydraulic mining sediments can concurrently facilitate more frequent floodplain inundation, foster the growth of riparian vegetation, and improve flood conveyance. These floodway enhancement opportunities should be fully leveraged in preference to expanding the floodways at the expense of highly productive agricultural land.

The region recognizes the importance of planning and implementing multi-objective projects. In fact, the Feather River corridor already supports a number of habitat restoration and augmentation projects, including the Levee District 1 Star Bend setback levee along the west levee of the Feather River and the recently constructed TRLIA setback levees along the Feather River east levee and Bear River north levee. Additional restoration projects, integrated corridor management plans, and improved management practices are being implemented. These efforts should be included in the overall evaluation of regional consistency with the CVFPP multi-objective goals.

Nevertheless, the Plan recognizes that restoration of ecosystem function will occur incrementally over time, where compatible with flood management projects, with appropriate funding, and where locally supported. Flood management projects alone will not be sufficient to restore ecosystem function in the region--it will take a diverse range of programs, funding sources, and volunteer efforts sustained over time to accomplish this goal.

Regional Setting and Demographics

The Feather River Region, as defined in this Plan, lies in the east-central portion of the Sacramento Valley, a broad, gently sloping valley that drains into the Sacramento-San Joaquin Delta (Delta). It is home to over 160,000 people and incorporates an area of approximately 302,000 acres of levee-protected lands within Sutter County, Butte County, Yuba County, and a very small portion of Placer County along the Bear River near Wheatland as shown in Table ES-1. Except for the flood channels themselves, the entire region is protected by levees which are included in the State Plan of Flood Control. The region extends about 56 miles from north to south and between 5 and 17 miles from west to east.

Table ES-1. Populations of Cities and Communities in the Feather River Region

City or Community	County	Population ¹
Yuba City	Sutter	63,328
Linda	Yuba	17,773
Olivehurst	Yuba	13,656
Marysville	Yuba	12,073
Live Oak	Sutter	8,392
Gridley	Butte	6,584
Tierra Buena	Sutter	4,587
Wheatland	Yuba	3,456
Sutter	Sutter	2904 ³
Biggs	Butte	1,707
Rio Oso	Sutter	356 ³
Nicolaus	Sutter	280 ²

¹ U.S. Census, 2010,

² Population Sign in Nicolaus, CA

³ U.S. Census, 2012

Approximately 76 percent of the land area within the region is actively farmed agricultural land, 16 percent is native vegetation or grazing land and 8 percent is urban and built-up land.

For the past 150 years agriculture has been the most important land use, and remains the foundation of the region's economy. Highly productive farms, many of them during the gold rush to supply the burgeoning mining industry, continue to produce a wide variety of rice, nuts, fruits, and row crops. These farms in turn support hundreds of businesses which supply equipment, fuel, chemicals, and technical support to farmers, and purchase, process, package, and transport crops on their way to markets all over the world.

Agriculture supports the cities, towns, and rural communities in the region. It is at the heart of its culture, history, and social life.

Despite the risk of flooding, the regional agricultural industry has thrived in the area due to the rich alluvial and floodplain soils deposited over thousands of years, plentiful water, and excellent climatic conditions for a wide variety of highly marketable crops and large public investment in flood protection infrastructure. Compatible use of agricultural, recreational, and wildlife areas make productive use of lands which would otherwise pose excessive flood risks for residential, commercial, and industrial development. It is therefore of great regional importance to

formulate a regional flood management plan to promote flood-compatible land uses in the floodplain while reducing the risk of flooding and allowing economic prosperity in the region.

Major north-south State highways include Highways 70, 99, 65 and 113. Major east-west State highways include Highways 163 and 20. Two Union Pacific Rail lines, the Valley and Sacramento Sub-lines, pass through the Region from north to south through Biggs, Gridly, Live Oak, Yuba City, Linda, Olivehurst, Marysville, and Wheatland along the way. These lines cross at Binney Junction in northern Marysville.

The Sutter County Airport and the Yuba County Airport are located near each other, in the southern portion of the Yuba City-Marysville metropolitan area, on the west side and east side of the Feather River, respectively.

Prior to 1848, when the Gold Rush set off a huge, rapid influx of settlers, the region was occupied by Native American tribes, which lived by subsistence off of the abundant and diverse resources in the valley and foothills, including salmon, waterfowl, deer, elk, and acorns. The Native Americans adapted to the natural landscape and climate (Brewer, 1966), although records indicate that thousands died in a large flood at the beginning of the nineteenth century (USACE, 2011).

The low-lying portions of the valley were occupied by vast tule marshes, with riparian forests growing on the low, natural levees lining the meandering channels. At the higher elevations these marshes and riparian forests gave way to grasslands and oak woodlands (Brewer, 1966).

Although highly altered by human activities since the gold rush, the basic landforms of the region remain essentially unchanged: From west to east, they are basins, terraces, and alluvium, each landform being characterized by typical land uses and natural habitats. These include ricelands and managed wetlands; field and hay crops, and wetlands; riparian, and shaded riverine aquatic habitats. Degradation of natural habitats and the interruption of natural ecological processes have altered and stressed fisheries and wildlife populations.

With its Mediterranean climate, the region is characterized by a well-defined cool wet season lasting generally from October through April, followed by a hot dry summer. With the Sierra Nevada Mountains to the east, and the exposure to the influence of storms sweeping in from the Pacific Ocean, the region can be subjected to rapid, extreme, and persistent flooding. The watersheds of the Feather River, Yuba River, and Bear River are capable of generating extreme peak flows when warm Pacific storms sweep in from the southwest, with high winds and ample moisture and release torrential rains as they are lifted over the mountains (Kelley, 1989), especially when combined with large snowmelt volumes from the Sierra Nevada Mountains.

Large floods were frequent in the nineteenth century, with high water events recorded for the Sacramento Valley in 1850, 1852, 1853, 1861-62, 1866-67, 1868, 1872, 1873, 1875, 1881, 1889, and 1892-93 (Kelley, 1989). Large floods have continued into the twentieth century as well, including 1902, 1907, and 1909, 1928, 1937, 1940, 1942, 1950, 1955, 1964, 1986, and 1997. The flood of 2006 so far has been the only event in the twenty first century.

Flood Management System

The flood management system which currently provides protection to the Feather River Region includes upstream reservoirs with active flood control space, levees along the major watercourses acting as flood control channels during high water events, and drainage facilities

which pump interior runoff and seepage from levee protected areas back into the flood control channels. It is part of a vast system of multi-purpose reservoirs, leveed stream channels, weirs, and overflow structures which has been constructed to reduce flooding in the Sacramento Valley over the past 160 years. These facilities are included in the State Plan of Flood Control for the Sacramento River Basin and are illustrated on Figure 2-2.

Reservoirs in the region with an active flood control function include Lake Oroville on the Feather River, operated by DWR, and New Bullards Bar Reservoir, on the Yuba River, operated by YCWA. Camp Far West Reservoir on the Bear River, operated by South Sutter Water District, does not provide any dedicated flood control storage and is typically full and spilling during flood events. However, the existence of the water supply facility does serve to attenuate a portion of the peak flow as it passes through the surcharged reservoir.

SPFC levees line the Cherokee canal north of the Sutter Buttes, the Feather River downstream of Thermalito Reservoir, the perimeter of Marysville, the Yuba River north of the Yuba Goldfields, the lower Bear River, Yankee Slough, the Western Pacific Interceptor Canal, the Sutter Bypass, and Wadsworth Canal, (and the West Intercepting Canal and East Intercepting Canal which feed into it) and the Natomas Cross Canal (see Figure 2-2)

The flood management system is operated to safely convey flood flows, through the coordinated efforts of local, State, and federal agencies. Flood control system operations includes the operation and maintenance of the multi-purpose reservoirs protecting the region; operating and maintaining the levee system; hydrologic monitoring and flood forecasting, and coordinated flood operations under the Standardized Emergency Management System (SEMS).

Non-structural flood risk management elements include a wide range of measures that limit the risk of flood damage primarily by avoiding or reducing the exposure to damaging flood waters rather than by confining those flood waters with larger and stronger hydraulic structures. These elements include raising and waterproofing structures so that they will be above anticipated flood levels or unharmed by flood waters, purchasing and relocating at-risk structures, limiting development in floodplains through the acquisition of agricultural and habitat conservation easements, establishing open space easements, regulatory constraints, and incentive programs. Restoration of floodplains where feasible, to provide additional flood channel storage and conveyance capacity, is often regarded as a non-structural element because it reduces, rather than increases, the confinement of floodwaters in existing channels.

Flood Management Challenges and Constraints

The regional flood management system consists of many inter-related elements that work together to reduce the risk of flooding. While portions of the regional system, such as the levees, have been constructed and improved upon over a period over 160 years, other elements, such as reservoirs, flood insurance, and environmental regulations, have been more recent.

Improvements in any portion of the system may improve its overall function, but a comprehensive evaluation is needed to identify the most cost effective and reasonable combinations of actions. While the regional flood management system was initially constructed with local resources, without any centralized control, the system is now highly regulated, funded from multiple sources, and involving the participation of a multitude of agencies.

The regional flood management system includes the flood control structures in the region, including levees, channels, drainage facilities, and reservoirs. It also includes the multitude of

State and federal agencies, programs, policies, and procedures which profoundly affect how future regional flood management elements are designed, financed, and constructed, how the system is operated and maintained, and how the economic stability and environmental quality of the region are improved over time.

Levees: The regional levee system was built over many years using available materials. While substantial work has been completed to upgrade urban levees in the region, portions of the levee system suffer from structural instability, erosion, settlement, inadequately designed or decaying penetrations, excessive vegetation, rodent damage, and encroachments. Meanwhile, the number of people and the importance of the infrastructure they protect have grown tremendously, with a resultant high risk to life and property in the region. Appendix A includes a detailed discussion of the specific levee deficiencies which have been identified based on operational experience during floods and technical studies such as DWR's Urban Levee Evaluation Program and Non-Urban Levee Evaluation Program.

Channels: Channels in the region must be managed to address the impacts of localized erosion, sedimentation, and vegetation growth, which both impedes floodwater capacity and provides critically important wildlife habitat. Improved collaboration among maintaining and regulatory agencies, combined with flood corridor planning, offers the opportunity to optimize channel benefits of flood conveyance and wildlife habitat. From a regional perspective it is critically important that flood conveyance capacity continues to be the top management priority.

Reservoirs: Reservoirs in the region, such as Lake Oroville and New Bullards Bar Reservoir meet many important regional and State water management objectives. However, with current flood storage, release capabilities, and operational criteria, storms larger than the 1997 flood would likely result in flows that exceed channel capacities. There are opportunities to make both operational and structural improvements which can substantially improve their effectiveness in reducing flood risk, including structural improvements, Forecast Coordinated Operations, and Forecast Based Operations.

Fisheries and Wildlife Habitat: Fisheries and Wildlife habitat have been substantially altered and degraded over the past 160 years through the construction of flood control levees, dams, and diversion structures, as well as land use changes across the region. There are opportunities to improve these habitats as part of multi-objective flood risk management projects, consistent with the goals of the CVFPP and the regional objectives. The region seeks to integrate agricultural land preservation, habitat enhancement, and restoration opportunities where feasible. The report describes strategies for preserving agricultural lands along flood corridors in ways that are wildlife friendly, describes habitat enhancement and restoration opportunities, and explores environmental compliance and mitigation solutions. Regional Habitat Conservation Plans and River Corridor Management Plans (CMP) offer potentially effective solutions to the current piecemeal approach to mitigating effects on fisheries and wildlife habitats. Additionally, preserving and protecting existing agriculture, encouraging cost-effective strategies to improve habitat values of agriculture and by incorporating habitat improvements in flood control projects will improve the overall ecosystem.

Operation and Maintenance: Operation and Maintenance constraints have increased costs and made it progressively more difficult to meet levee maintenance standards. Complex, time consuming, and expensive permitting processes create hurdles for LMAs which have historically

had the freedom and license to clear vegetation, repair erosion sites, restore levee sections, and resurface roads from late spring through fall.

Among the many challenges faced by LMAs and DWR in its role as maintaining agency include:

- Encroachments by underlying or adjacent property owners which threaten levee integrity, inspections, or flood fighting. They are difficult, expensive, and time consuming. Historically the LMAs have received inconsistent and limited support for encroachment removal from the CVFPB and the Office of the State Attorney General.
- Deteriorating levee penetrations for water supply and drainage as well as other purposes can create dangerous, but difficult to detect weaknesses.
- Levee slope instability, erosion, caving, cracking, seepage, rutting, rodent burrowing, loss of vegetative cover, loss of revetment.
- Boundary and property management costs, including surveys, boundary markers, title research and legal costs, all of which can be very costly and time consuming, given the complexity of underlying property rights associated with regional flood management facilities. LMAs have found that the easement system is very cumbersome and difficult to administer over time; fee simple ownership of land underlying their facilities greatly reduces the opportunity for misunderstanding and conflict.
- Rising insurance and personnel costs.
- Vandalism, dumping, and trespass (especially driving motorcycles and four-wheelers on levee slopes), and petty criminal acts are major concerns. Recently the theft of copper wire and other metals have become rampant in some areas, affecting pump stations, lighting, control panels, and other structures. In some cases, heavy K-rails and concertina wire have been needed to block trespass on critical infrastructure such as pump stations. Patrols and enforcement costs add to the cost of protecting critical infrastructure.
- In general, the LMAs in the area, including DWR Sutter Yard, are not adequately funded to address major maintenance repairs. Special funding sources and programs are needed to address these needs.

The region is now working with a multitude of State and federal agencies to develop management tools and practices which can achieve both operational efficiency and flood risk management goals.

Flood Risks and Levee Performance Evaluation: Flood risk is the combined effect of the chance of flooding and the consequences of flooding. As development occurs within levee-protected areas, flood risk increases as well. Climate change could also result in more extreme rain floods, which will increase the chance of overwhelming the regional flood management system.

Meanwhile, in the aftermath of major flooding elsewhere in the country, such as the 2005 flooding of New Orleans, USACE has been creating a more conservative framework for risk assessment, with the net effect of downgrading the flood protection ratings of flood protection facilities.

The Federal Emergency Management Agency is working nationwide to re-map levee-protected regions across the country, using current engineering standards and data. The net effect in many

areas, including the region, will be de-certification of levee systems previously deemed adequate. The revised flood hazard ratings will in turn have significant economic impacts on affected areas, due to increased flood insurance costs, limitations on economic development, and the need to fund additional levee improvements.

The State, through Senate Bill 5, passed in 2007 has also set 200-year flood protection as the minimum standard for urban areas, which is a significant increase over the 100-year level of protection required by the Federal Emergency Management Agency to remove protected areas from the regulatory floodplain.

These increasingly stringent standards create a difficult challenge for rural areas, including most of the Feather River Region, in that there are a multitude of levee sites which need to be repaired to restore the historic design function, but the new standards, largely established to meet urban requirements, would result in repairs which are too expensive for the rural Levee Maintaining Agencies to pay for. The region is supportive of current efforts by DWR to work with the flood management community to develop rural levee repair standards which will facilitate affordable repairs of multiple sites.

Alternatives Formulation, Evaluation, Comparison, and Prioritization

Alternatives for improving flood risk management, while achieving other program goals and objectives, include both structural and non-structural elements. As described in this report, the various alternatives are grouped by type and region. Chapter 5 describes the major solution strategies which have been used, and are proposed, to meet the goals and objectives of the region. Chapters 6, 7, 8, and 9 describe specific types of actions related to improving agriculture and wildlife habitat, recreation, flood risk reduction structures, and residual risk management actions, which when combined, can create highly effective multi-objective projects which help achieve the region's goals and objectives.

Structural improvements are grouped by basins and responsible agencies, reflecting contiguous areas protected by discrete set of levee units. Agricultural land preservation, integrated wildlife habitat enhancement opportunities, and recreational opportunities are discussed in terms of regional strategies and specific enhancement opportunities. Other categories of alternative projects include channel improvements, reservoir structural improvements, reservoir operations, and residual risk management.

As reflected in this report, regional flood risk management efforts in this region have been underway since the 1850's. Many of the actions described in this report are currently underway or have been recently completed, but are nevertheless described to provide continuity and context. For example, the Three Rivers Levee Improvement Authority has nearly completed construction of 200-year levee improvements for Reclamation District 784 levees; the Marysville Levee Commission is currently working with USACE and the State to complete improvements to its ring levee system, and the Sutter-Butte Flood Control Agency is beginning construction of its Feather River west levee improvements. Some districts, such as Reclamation District 10 and Reclamation District 1001 are just beginning evaluations of possible courses of action.

It is the intent of the Plan that the specific actions described in Chapters 6, 7, 8, and 9 be combined during implementation as multi-objective projects which achieve the primary goal of improving flood risk management and advance the supporting goals as well. The actions are described separately in this Plan because it is premature to define fully integrated projects prior

to the formulation of detailed project design features, identification of funding sources (including incentives and constraints), and development of implementation plans.

An important outcome of the public review of this draft report and preparation of the final report will be ongoing review and comment by all interested parties, leading to a refinement of the list of alternative actions and the proposed evaluation, comparison and prioritization framework over time. The proposed evaluation, comparison, and prioritization of these alternatives will be based on the extent to which they achieve the goals and objectives of the CVFPP, the regional objectives, cost, and feasibility, as suggested by Table 10-1.

Financial Plan Formulation

The Financial Plan includes a description of the regional economic profile in order to set the context for local funding. The region is primarily characterized by the rural agricultural economy, has relatively low household incomes, low commercial rents and high unemployment rates as compared to California and the nearby Sacramento Region. The region has planned for modest growth (approximately 2% annualized growth) over the next 25 years with the growth focused primarily in Yuba City and south Yuba County. However, development of this planned growth will be dependent upon real estate market cycles and the ability for the region to attract new employment opportunities.

The Financial Plan provides a detailed discussion of the various potential State and Local funding sources available to fund the projects identified in the plan. The Financial Plan also includes a detailed discussion of the recent progress the various sub-areas of the region have made funding and financing completed and ongoing projects. The Financial Plan provides a detailed discussion of the projects identified within this RFMP and identifies potential approaches to fund these projects in the future.

As whole, the region has taken steps to implement many new local funding mechanisms such as assessment districts and fee programs and the region has received a significant amount of funding from the State to implement flood risk reduction projects. An estimate of the local funding capacity for each sub-region has been prepared and the Financial Plan concludes that many of the sub-areas in the region have already exceeded this estimated capacity with the currently in place funding mechanisms. Only a few of the sub-areas have remaining marginal funding capacity to advance the proposed projects identified within this RFMP given the current constraints on generating new funding.

As the region evaluates and advances projects identified within this plan, it will need to perform more detailed evaluations of potential new local funding sources. To that end, there are several near and long term recommendations presented by the region where the State and DWR could provide support to local entities. These recommendations include directly funding local efforts through the feasibility study process to help evaluate and establish local funding mechanisms, promoting the establishment of funding mechanisms that link the costs of the flood control system to all of the beneficiaries of the flood control system, and promoting NFIP reform. In summary, the information within the Financial Plan will be helpful in setting realistic regional implementation priorities and timelines.

1 Introduction

1.1 Purpose of Report

The Yuba County Water Agency (YCWA), Three Rivers Levee Improvement Authority (TRLIA), Marysville Levee Commission (MLC), and Sutter Butte Flood Control Agency (SBFCA) have partnered with the State of California Department of Water Resources (DWR) to develop this Feather River Regional Flood Management Plan (“RFMP” or “Plan”). This Plan reflects the flood management priorities of the Feather River Region while aligning with the recently adopted 2012 Central Valley Flood Protection Plan (CVFPP) to the extent feasible. By clearly establishing regional flood management priorities, this Plan will facilitate future funding and implementation of much-needed flood risk reduction projects.

Although funded by DWR, the intent of all five partnering agencies (YCWA, TRLIA, MLC, SBFCA, and DWR) is to facilitate the development of a broadly supported Plan and embrace the FloodSAFE vision. This Plan is being shaped by the concerns and priorities of the communities in the Feather River Basin, including local Levee Maintaining Agencies (LMAs) representatives, elected officials, property owners, businesses, interested individuals, small community representatives, native tribes, and non-governmental organizations. Accordingly, the planning process is founded on a strong strategic stakeholder outreach effort. Concurrent goals of the outreach effort are to strengthen inter-agency working relationships, engender region-wide understanding of integrated flood management goals, objectives, and needs, and promote a sustainable partnership structure to facilitate future implementation of mutually-beneficial projects.

A diverse range of stakeholders, often with divergent interests and opinions, participated in this process. While all of these interests and opinions were carefully considered, it is ultimately the responsibility of the four local partnering agencies to formulate the perspective and recommendations of the region as documented in this report. For simplicity, these are attributed to “the region” throughout this report.

1.2 The Planning Process

The plan formulation tasks focus on developing a description of the current state of flood management within the region, identifying opportunities for improving flood management while achieving multiple objectives, setting priorities, and developing a financing plan. Together, these elements will define the long-term vision for flood risk reduction in the region.

The proposed approach involves a structured public outreach process supported by available engineering, environmental, and financial analyses leading to the incremental formulation of the RFMP. A website (<http://frfmp.com/>) and hotline (530-845-5988) were established in March 2013 to provide ready access to the planning team and the evolving documents compiled in the course of the planning process. The schedule of activities, meeting notices and summaries, briefing materials, the draft and final report, and supporting documents are posted on the website as they become available. In addition, the website includes links to key agencies and other planning processes.

These materials are also distributed via email to all interested parties. A link to register as an interested party is available under the “Contact” link on the website.

In order to provide opportunities for effective input in the planning process without creating an undue burden on the communities in the planning area, planning meetings are aligned with existing public meetings of the various involved agencies to the extent feasible. These include reclamation districts (RD), cities, counties, and communities; supported by a few workshops specifically devoted to the Plan’s formulation effort, as shown in Figure 1-1.

1.3 Relationship with the Central Valley Flood Protection Plan

The CVFPP is a critical document to guide California’s participation (and influence federal and local participation) in managing flood risk along the Sacramento River and San Joaquin River systems. The CVFPP proposes a system-wide investment approach for sustainable, integrated flood management in areas currently protected by facilities of the State Plan of Flood Control (SPFC). The CVFPP will be updated every five years, with each update providing support for subsequent policy, program, and project implementation.

DWR conducted planning and investigations for the 2012 CVFPP from 2009 through 2011, representing the most comprehensive flood evaluations for the Central Valley ever conducted by the State. The CVFPP was adopted by the Central Valley Flood Protection Board (Board or CVFPB) on June 29, 2012. During the review and adoption process regional representatives expressed support for the goals and objectives set for the CVFPP, as well as concerns about the potential expansion of the Sutter Bypass and creation of a new Feather River Bypass. The CVFPB responded to these concerns in its adoption resolution 2012-25, including deletion of the Feather River Bypass from the CVFPP.

Given its vast scope, the CVFPP could not incorporate the level of detail needed to specifically delineate likely system-wide improvement alternatives, nor did it include a detailed discussion of local flood risk reduction priorities. Instead, it provides a broad vision to help guide regional- and State-level financing plans to guide investments which may be in the range of \$14 billion to \$17 billion over the next 20 to 25 years.

In order to bring that process to fruition with the necessary level of detail and opportunity for full local participation in the planning process, the 2017 update to the CVFPP will be informed by regional flood management plans, such as this one, two basin-wide feasibility studies, and the Conservation Strategy. The Conservation Strategy expands upon the Conservation Framework that was included in the 2012 CVFPP.

The regional planning effort has been subdivided into regions (Figure 1-2). At the request of the involved regional agencies, several of the original nine regions were consolidated into six. The regional plans are intended to clearly define local and regional flood management needs, priorities, and financing capabilities.

The two Basin-Wide Feasibility Studies (BWFS) will cover the Sacramento River Basin and the San Joaquin River Basin, respectively. They will primarily focus on the long-term needs of the SPFC to provide trans-regional benefits and improvements to the capacity, flexibility, and resiliency of the Central Valley Flood Management system.

DWR has indicated that grant funding guidelines for future flood risk management programs will most likely prioritize State cost share funding for individual projects, taking into account the

extent to which these project proposals are compatible with the vision, guiding principles, and elements of the CVFPP. DWR will likely also consider the availability of limited State funding and indices of effectiveness, such as net benefits, benefit to cost ratios, and other measures when prioritizing the allocation of State funds.

The Feather River Regional Flood Management Plan formulation process is an integral part of the CVFPP process. It provides an opportunity for the region to bring into focus flood management issues of local concern, devise solution options, set priorities, and explore local financing mechanisms to help pay for planning, design, construction, and operation and maintenance. It also provides an opportunity for the region to offer recommendations to DWR in support of the SSIA refinement process. This effort, while coordinated with the larger CVFPP, will build on the successes of projects implemented in the region since the 1986 flood, and to obtain State and federal cost sharing to the maximum extent feasible.

It is especially important that the region expedite the planning process to take advantage of remaining Proposition 1E (Disaster Preparedness and Flood Prevention Bond Act of 2006) and Proposition 84 (The Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Bond Act of 2006) bond funds, which were authorized in 2006, but expire if not committed by the end of 2016. It is anticipated that compatible portions of the evolving Feather River Regional Flood Management Plan (RFMP) will be incorporated into the Sacramento River BWFS and the CVFPP, which will facilitate future State and federal cost sharing contributions to these elements.

Consistent with the input provided to the CVFPP during the CVFPP adoption process, the region remains concerned about the potential loss of agricultural lands and resultant economic impacts (Hamilton and O'Brien, 2013), redirected hydraulic impacts, and public expense associated with the implementation of the Sutter Bypass expansion and the creation of a new Feather River Bypass. While the Feather River Bypass does have the potential to reduce the flood risk of the urban communities in our region, the impacts and costs do not appear to justify further consideration of this alternative. If the BWFS is going to evaluate measures to reduce the flood risk beyond the 200 year level that will be accomplished by the urban levee improvements currently underway, consideration should also be given to evaluating new or expanded reservoirs as alternatives to the Feather River Bypass and widening of the Sutter Bypass to achieve the goals of providing resiliency, adaptability to climate change and integrated water management.

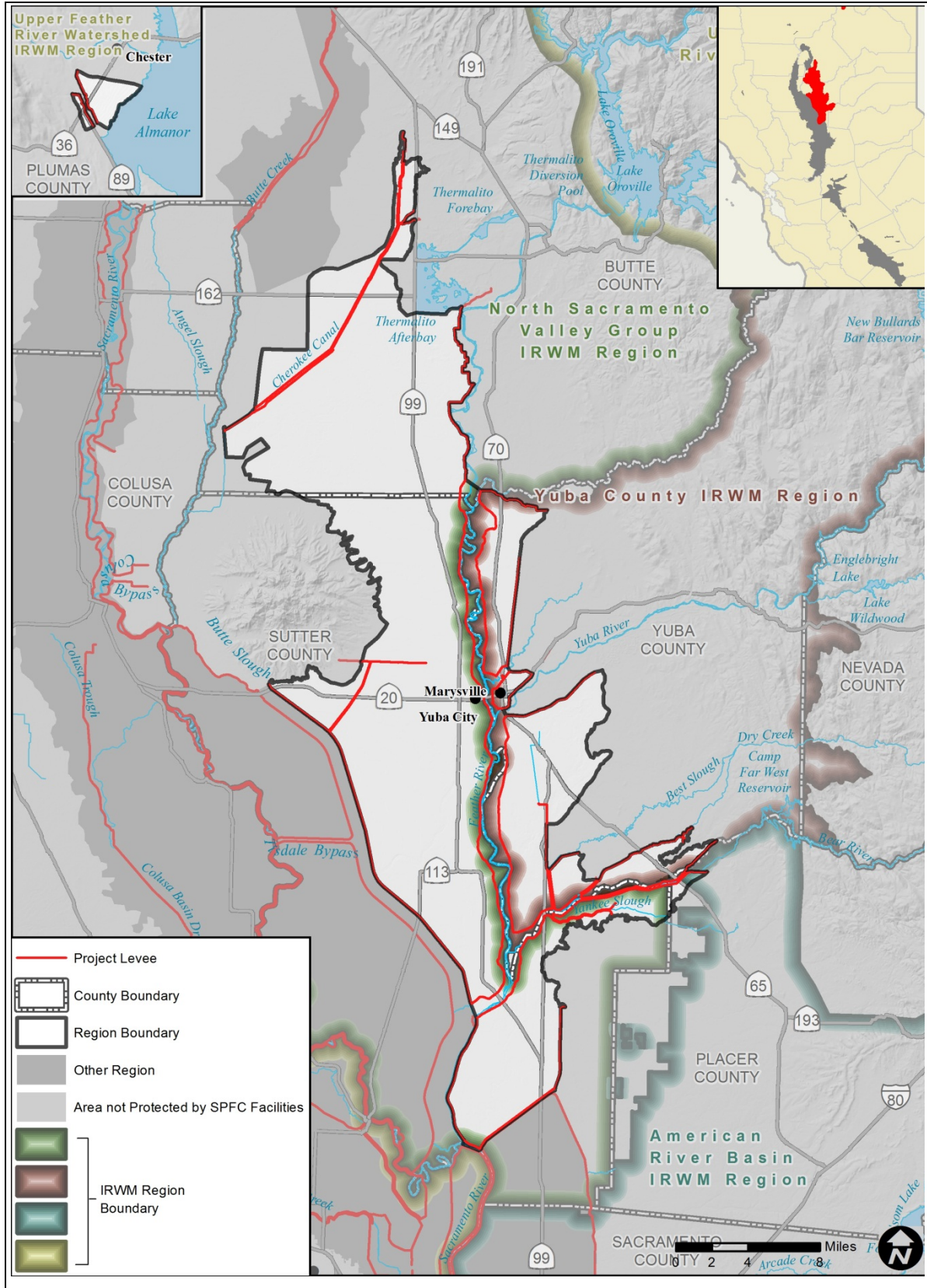


Figure 1-1. Feather River Region Flood Management Planning Area (DWR 2012)

1.4 Use of Existing Information

The regional planning process is intended to move forward swiftly, with an anticipated duration of 12 to 18 months. It will rely primarily on existing information provided by local agencies, property owners, businesses, interested individuals, native tribes, non-governmental organizations, as well as State and federal agencies. In particular, the process will rely heavily on the detailed operational knowledge of the flood system of the LMAs, the voluminous results of DWR's CVFPP formulation efforts over the past five years, and the U. S. Army Corps of Engineers (USACE). Some limited additional technical studies may be conducted to help in the plan formulation process as needed.

Existing State documents of particular importance in this process include:

- Central Valley Flood Protection Plan (2012), including attachments and CVFPB Resolution 2012-25
- 2012 CVFPP Conservation Framework and 2014 draft Conservation Strategy(unpublished)
- Flood Control System Status Report (FCSSR) (2011)
- State Plan of Flood Control Descriptive Document (2010)
- Feather River Region Flood Atlas—Draft (July 2013)
- Regional Flood Management Planning Initiative, Guidelines for Directed Funding to Prepare Regional Flood Management Plans (2012)
- Draft Lower Feather River Corridor Management Plan (April 2014)
- Central Valley Joint Venture 2006 Implementation Plan
- Riparian Bird Conservation Plan – Partners in Flight
- Refuge and Wildlife Area Management Plans

1.5 Organization of the Planning Team

The YCWA, TRLIA, MLC, and SBFCA executed a Memorandum of Understanding (MOU) on September 12, 2012, to establish local cooperation and coordination in the regional plan formulation process. Under the MOU, the agencies created a Coordinating Committee with six members selected to represent them in the plan formulation process, established a governance structure for the Committee, and appointed SBFCA to act as administrator of the funding agreement with DWR.

The partnering local agencies and the Coordinating Committee are supported by a consultant team selected to provide the range of technical expertise required to successfully complete the planning process.

1.6 Organization of this Report

This report is organized to reflect the natural chronological sequence of the planning process. Beginning with a description of background information and the regional setting, the report describes regional problems and opportunities. These guide the formulation of goals and objectives. Potential management actions that can achieve the goals and objectives are

identified. Alternative solutions are then formulated from combinations of such actions. These alternatives are then evaluated to determine the extent to which they achieve the goals and objectives, ancillary benefits, costs, and impacts. The means and opportunities for financing proposed alternatives are formulated and described. Based on all of these elements, a locally determined plan is formulated and documented. Technical appendices provide documentation and additional detail regarding the planning process and the substance of the RFMP.

1.7 Regional Goals and Objectives

The regional goals and objectives are to improve flood risk management in the region while advancing the supporting goals of improving operations and maintenance, promoting ecosystem functions, improving institutional support, and promoting multiobjective projects. These objectives of the regional planning process are founded on, and consistent with, the goals of the CVFPP as described in the 2012 Plan. These goals and objectives are intended to address the specific public safety, environmental quality, and economic health concerns of the region as described in Chapter 3 and 4 of this report. Specific objectives for the region have been formulated as well, to reflect the history, culture, land use, hydrology, and economic needs of the region. Chapter 5 describes the major solution strategies which have been used, and are proposed, to meet the goals and objectives of the region. Chapters 6, 7, 8, and 9 describe specific actions, which when combined, can create highly effective multi-objective projects which help achieve the region's goals and objectives.

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 system-wide 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 operations and maintenance, 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 to the extent feasible.
- **Improve Institutional Support** – Develop stable institutional structures, coordination protocols, and financial frameworks that enable effective and adaptive integrated flood management (designs, operations and maintenance, 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.

These goals provide guidance for the formulation of its specific policies and physical elements. The goals also capture guidance and objectives provided in the authorizing legislation (California Water Code Section 9616) (DWR 2012). DWR also prepared the Conservation Framework which is an integral part of the SSIA identified in the 2012 CVFPP and describes how Environmental Stewardship is integrated to make progress towards meeting the environmental objectives of the Central Valley Flood Protection Act of 2008 throughout the flood management system. In April 2014 DWR completed an administrative review draft of the 2017 Conservation Strategy, which although unpublished, has been helpful in advancing the region's effort of aligning proposed actions with DWR's goals and objectives.

The goals of the RFMP are consistent with the broader goals of the CVFPP. The primary goal of the RFMP is to collaboratively improve flood risk management within the region, while improving operations and maintenance, promoting ecosystem functions, improving institutional support, and promoting multi-benefit projects. By aligning as closely as feasible with CVFPP goals the region seeks to maximize State and federal cost sharing and to execute high priority projects, consistent with the Regional Plan, as rapidly as feasible. Specific objectives include:

- **Urban and Urbanizing** - Provide 200-year flood protection for urban and urbanizing areas of the region, including Marysville, Yuba City area, portions of Sutter, RD 784 and Wheatland.
- **Small Communities** - Provide 100-year flood protection for the small communities in the region, including Rio Oso, Nicolaus.
- **Rural Agricultural Areas** - Improve flood protection and resiliency for the rural agricultural areas within the region.
- **Flood System Sustainability** - Improve the flexibility and sustainability of the regional flood management system in light of climate change and regulatory constraints by reducing the costs and increasing the effectiveness of levee maintaining agencies.
- **Agricultural Sustainability** - Support and strengthen the regional economy, primarily founded on highly productive farmland; achieve wildlife habitat objectives through preservation and/or modification of current agricultural practices to the extent feasible; and modify State and federal floodplain regulations to help sustain agricultural uses of regional floodplain.
- **Multiple Objectives** – Promote and incorporate multiple objectives such as environmental restoration, agricultural enhancement, improved water quality, open space, energy production, and recreation, to the extent compatible with existing land uses.
- **State System-wide Investment Approach (SSIA) and Regional Projects** - Describe opportunities to link SSIA to regional projects and/or objectives. Accordingly, describe challenges of these linkages.

The proposed regional Plan will achieve these goals and objectives through both structural and non-structural means, as described in subsequent sections of this Plan.

While the regional goals and objectives are consistent with the CVFPP goals, the regional objectives place a greater emphasis on the preservation of economically productive agricultural land than does the CVFPP, for several reasons.

Agriculture provides the foundation for the regional economy. Loss of highly productive agricultural lands to accommodate larger flood conveyances, transient floodplain storage, and wildlife habitat could affect the long-term viability of the regional economy, including the many secondary and tertiary businesses that support agriculture.

There are many opportunities for improving the multi-objective benefits of productive agricultural land (an example is benefit to habitats), which can concurrently strengthen the economic viability of agriculture in the region. The region seeks to take maximum advantage of these evolving opportunities while minimizing future land use conversion to wildlife and fisheries habitat.

There are also great opportunities for further environmental enhancement and restoration of ecological processes within the floodways of the Feather, Yuba, and Bear rivers, which can be implemented as part of multi-objective projects which also improve flood conveyance. For example, removing and re-grading terraced hydraulic mining sediments can concurrently facilitate more frequent floodplain inundation, foster the growth of riparian vegetation, and improve flood conveyance. These floodway enhancement opportunities should be fully leveraged in preference to expanding the floodways at the expense of highly productive agricultural land.

The region recognizes the importance of planning and implementing multi-objective projects. In fact, the Feather River corridor already supports a number of habitat restoration and augmentation projects along much of its length, including the Levee District 1 Star Bend setback levee along the west levee of the Feather River and the TRLIA setback levees along the Feather River east levee and the Bear River north levee. Additional restoration projects, integrated corridor management plans, and improved management practices are being implemented. These efforts should be included in the overall evaluation of regional consistency with the CVFPP multi-objective goals.

Nevertheless, the Plan recognizes that restoration of ecosystem function will occur incrementally over time, where compatible with flood management projects, with appropriate funding, and where locally supported. Flood management projects alone will not be sufficient to restore ecosystem function in the region--it will take a diverse range of programs, funding sources, and volunteer efforts sustained over time to accomplish this goal.

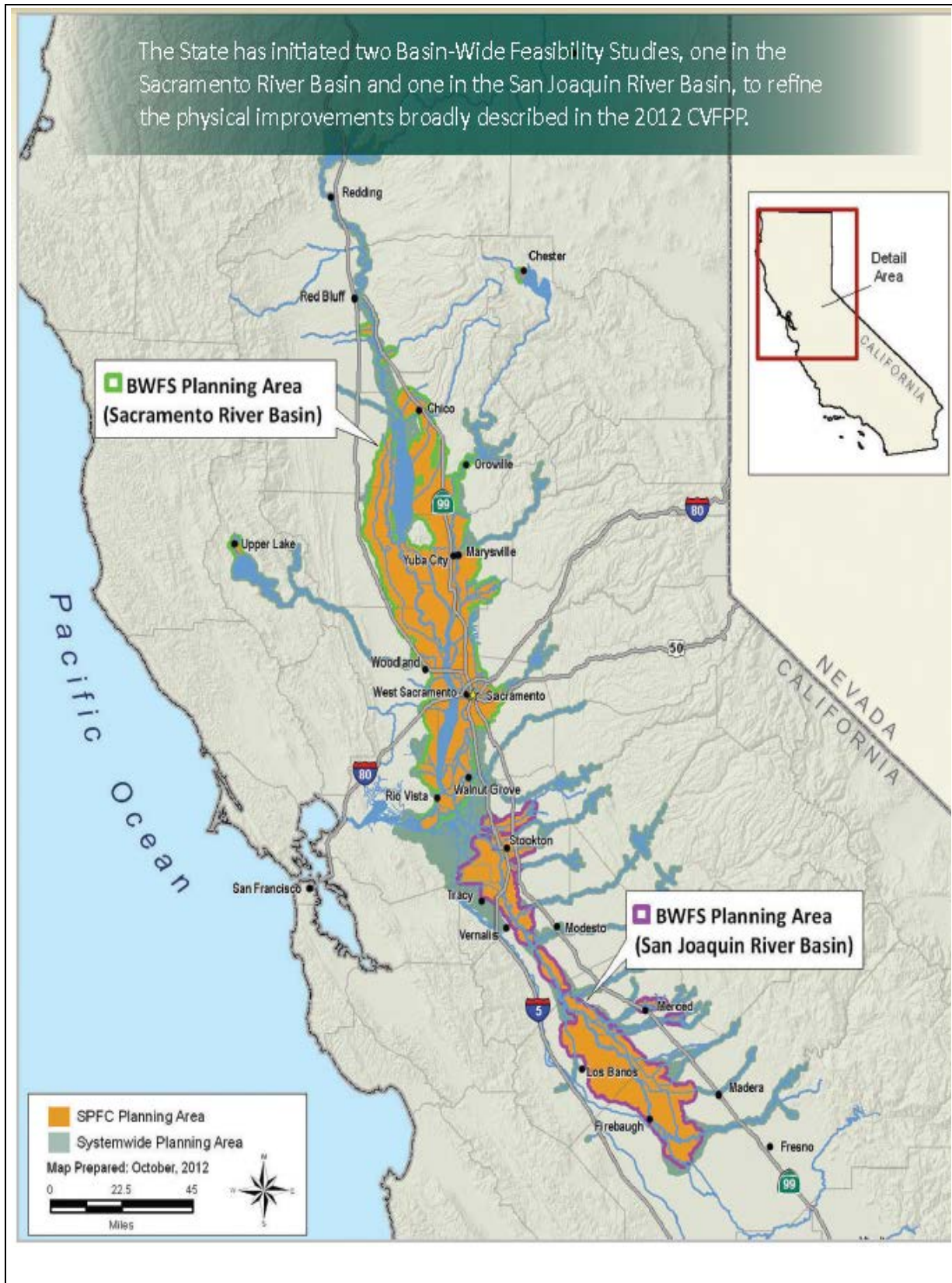


Figure 1-2. Study Area for Basin-Wide Feasibility Studies (DWR 2013)

2 Regional Setting and Demographics

2.1 Area and Boundaries

The Feather River Region, as defined in this Plan, lies in the east-central portion of the Sacramento Valley, a broad, gently sloping valley that drains into the Sacramento-San Joaquin Delta (Delta). It incorporates an area of approximately 302,000 acres of levee-protected lands within Sutter County, Butte County, Yuba County, and a very small portion of Placer County along the Bear River near Wheatland as shown in Figure 1-1. Except for the flood channels themselves, the entire region is protected by levees that are included in the State Plan of Flood Control. The region extends about 56 miles from north to south and between 5 and 17 miles from west to east.

From north to south the western boundary of the region follows the vicinity of the Cherokee Canal from the Junction of Highway 99 and Highway 149 to the base of the Sutter Buttes, the eastern base of the Sutter Buttes to the Sutter Bypass, then along the east levee of the Sutter Bypass to the Feather River, and then the east levee of the Feather River to the Natomas Cross Canal north levee.

From north to south the eastern boundary of the region follows the west levee of the Feather River from Thermalito Reservoir to Marysville, encompassing the floodplain east of the Feather River, including the lower Bear River and Wheatland, to the Natomas Cross Canal north levee.

The seven mile-long Natomas Cross Canal north levee constitutes the southern boundary of the region.

The rivers, bypass channels, creeks, and their floodplains that lie between the project levees in the region and convey its flood waters downstream (D/S) are included in the planning area because these areas are designated for flood conveyance, and thus may be affected by actions such as setback levees, changes in maintenance practices, environmental restoration projects, dredging, and changes in flow regime. Their characteristics, in terms of their conveyance capacity, fisheries and wildlife habitat quality, other resource benefits, and restoration opportunities are important and are considered in the planning process.

2.2 Population and Land Use

Approximately 76 percent of the land area within the region is actively farmed agricultural land, 16 percent is native vegetation or grazing land, and 8 percent is urban and built-up land.

For the past 150 years agriculture has been the most important land use, and remains the foundation of the region's economy. Highly productive farms, many of them established during the gold rush to supply the burgeoning mining industry, continue to produce a wide variety of rice, nuts, fruits, and row crops. These farms in turn support hundreds of businesses that supply equipment, fuel, chemicals, and technical support to farmers, and purchase, process, package, and transport crops on their way to markets all over the world.

Agriculture supports the cities, towns, and rural communities in the region. It is at the heart of its culture, history, and social life.

Despite the risk of flooding, the regional agricultural industry has thrived in the area due to the rich alluvial and floodplain soils deposited over thousands of years, plentiful water, and excellent climatic conditions for a wide variety of highly marketable crops and large public investment in flood protection infrastructure. Compatible use of agricultural, recreational, and wildlife areas make productive use of lands which would otherwise pose excessive flood risks for residential, commercial, and industrial development. It is therefore of great regional importance to formulate a regional flood management plan to promote flood-compatible land uses in the floodplain while reducing the risk of flooding and allowing economic prosperity in the region.

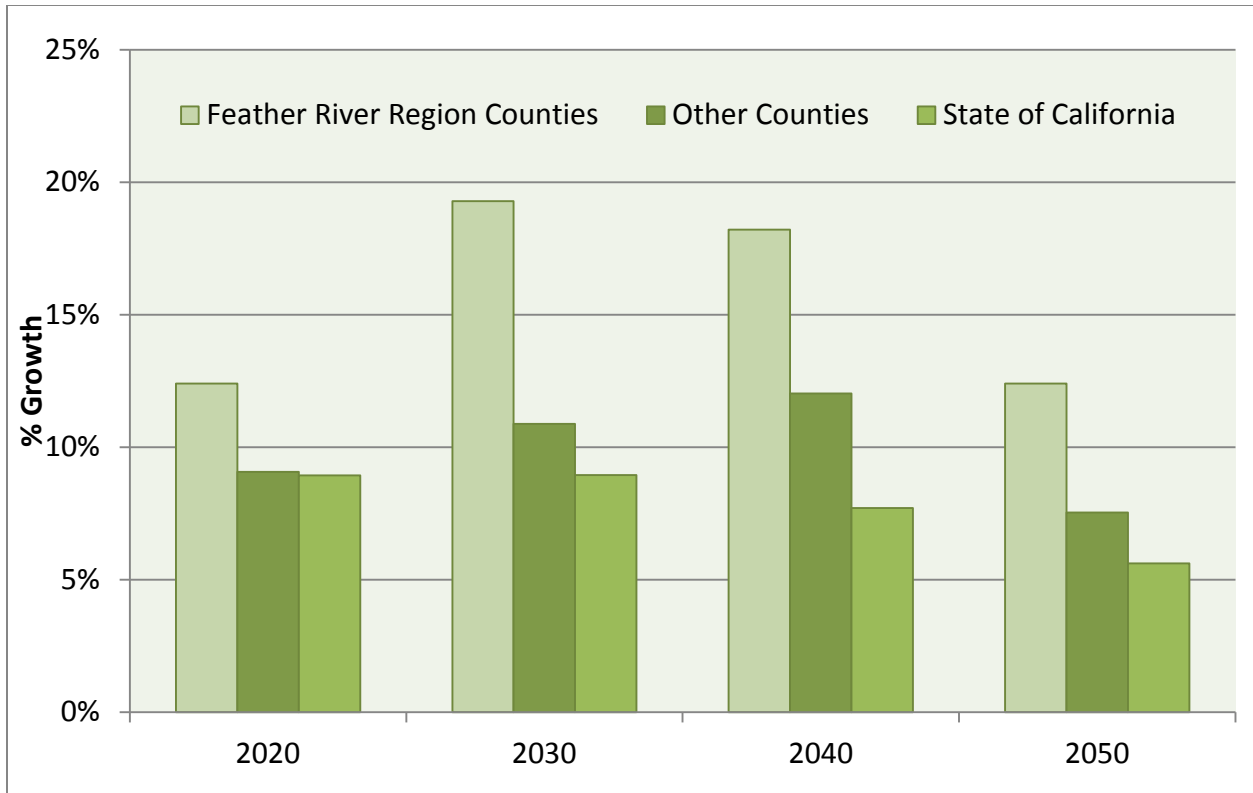
Based on 2013 census data, the region has a population of 160,645, with most residents concentrated in the communities of Yuba City, Linda, Olivehurst, Marysville, and Live Oak. The population within the region, and elsewhere in the State, is projected to grow considerably in the coming decades. Comparing the county populations in 2000 to those in 2010, regional counties have already seen as much as 20% growth in both Yuba and Sutter Counties. The State on the other hand saw 10% growth from 2000 to 2010. See Table 2-1 below for county populations and growth rates. According to the California Department of Finance, county populations in the Feather River Region are projected to grow at higher rates than other Sacramento River Basin counties. Figure 2-1a illustrates projected growth rates for Feather River Region counties as compared to other areas.

Table 2-1. Populations and Historic Growth of Feather River Region Counties

State or County	2000 Population¹	2010 Population²	% Growth
State of California	33,871,648	37,309,382	10%
Butte County	203,171	219,990	8%
Yuba County	60,219	72,329	20%
Sutter county	78,930	94,669	20%

¹ U.S. Census, 2000

²U.S. Census, 2010



Note: Other counties include, Colusa, Glenn, Sacramento, and Yolo Counties. Feather River Counties include Butte, Sutter, and Yuba Counties

Source: Department of Finance, 2010.

Figure 2-1a. Projected Populations for Feather River Region and Sacramento River Basin Counties

2.3 Key Infrastructure

Major north-south State highways include highways 70, 99, 65, and 113. Major east-west State highways include Highways 163 and 20. Two Union Pacific Rail lines, the Valley and Sacramento Sub-lines, pass through the Region from north to south through Biggs, Gridley, Live Oak, Yuba City, Linda, Olivehurst, Marysville, and Wheatland along the way. These lines cross at Binney Junction in northern Marysville.

The Sutter County Airport and the Yuba County Airport are located near each other, in the southern portion of the Yuba City-Marysville metropolitan area, on the west and east sides of the Feather River, respectively.

2.4 Ecological Setting

This section describes the fish and wildlife species and their habitats that occur in the Feather River region. The section emphasizes the species that are listed as threatened, endangered or as species of special concern by the state or federal governments. Both natural communities and agricultural lands that provide habitat for these species are discussed. The discussion is organized by the major landforms that occur in the region and the habitat types and land uses they support.

2.4.1 Landforms

The region can be divided into three main landforms that occur in roughly north – south trending bands across the landscape: basins, terraces, and alluvium. Each landform is characterized by typical land uses and natural habitats. The western part of the region consists of low-elevation basins, including the Butte Basin, north of the Sutter Buttes, and the Sutter Basin, south of the Sutter Buttes. Typical land uses in these areas are rice farming and wetland management for waterfowl (e.g., the Gray Lodge Wildlife Area).

To the east of these basins occur the higher-elevation terrace deposits of the Modesto and Riverbank formations, underlain by Laguna formation. Land use within this area is mainly agricultural, consisting mostly of orchards, with areas of field crops. Native habitat on this landform consists of grassland, although little of that remains in this area. Some parcels of grazing lands remain (e.g., east of Gridley).

The third landform is the alluvium of the Feather River and tributaries. The meander belt of the Feather River is narrowly constrained by erosion-resistant terrace deposits. Within the meander belt land uses are agriculture and wildlife management. Abundant riparian forest and scrub occur in the meander belt. The levees are mostly right adjacent to this meander belt downstream of Marysville/Yuba City, but generally set further back upstream of these cities.

There are approximately 20,000 acres of land within the floodways (i.e., between the levees) of the Feather River region (including the Feather River, Bear River, Dry Creek, and the Interceptor Canal). According to the Farmland Mapping and Monitoring Program, which bases its maps on soil quality and aerial photo analysis, 1,022 of these acres are classified as waterways, 466 acres are classified as urban and built-up land, 10,058 acres are classified as native vegetation and grazing land, and 8,841 acres are classified as prime farmland, farmland of statewide importance, or local and unique farmland (Farmland Mapping and Monitoring Program 2008-2010). The floodways support 4,848 acres of native riparian forest and woodland, 1,115 acres of native riparian scrub, 145 acres of wetlands, and 59 acres of stands of invasive riparian plants (California Department of Fish and Wildlife 2013).

Extensive areas along the river are in public or non-profit ownership, including the 2,522-acre Feather River Wildlife Area, the 430-acre Bobelaine Audubon Sanctuary, and the 11,869-acre Oroville Wildlife Area near Oroville (see Figure 2-1b). These areas support thousands of acres of riparian forest and scrub habitat, but also still offer opportunities of additional habitat restoration and enhancement to benefit fish and wildlife species.

Three major levee setbacks were recently constructed in the region: The Star Bend Setback Levee, (constructed 2009) (Stalker, 2009), the Bear River (north levee) Setback Levee (constructed 2005-2006) and the Feather River (east levee) Setback Levee (constructed 2008-2009).

The Star Bend Setback Levee project, sponsored by LD1 as an Early Implementation Project funded by DWR and local sponsors, included 3400 feet of new setback levee construction, which shortened the Feather River west levee at Star Bend, increased channel conveyance and storage capacity, and opened the area for habitat restoration (Starker, 2009).

The Bear River and Feather River levee setback projects were sponsored by TRLIA. Riparian habitat restoration has also been planned for both these areas, as well as continued farming practices in the Feather Setback Area. At the Bear River Setback, the entire 639 acres of riparian

habitat have been restored. In the Feather River, an additional 1600 acres were added to the floodway; 157 acres are used for ecological mitigation areas or as a vegetated wind wave buffer for the levee; 500 acres are planned to be converted into a FESSRO Advanced Mitigation Site; 470 acres are being evaluated for future restoration opportunities; and 473 acres are being evaluated for continued agricultural usage.

More opportunities for habitat restoration exist. Extensive areas are in agriculture within the floodways of the region. Within Yuba, Butte and Sutter Counties, over 20,000 acres of land in the floodway are farmed (Table 2-2, Bozzo pers. comm.2014).

To the east of the Feather River, the alluvial fans of the Yuba and Bear Rivers descend from the Sierra Nevada foothills, with mostly orchards on the fertile alluvial deposits and native riparian scrub and trees on the floodplain. Along the Yuba River, there are also orchards within the floodplain. Between the alluvial fans to the east of State Route 70 are lower terraces with impervious subsoils that support rice farming.

2.4.2 Ricelands and Managed Wetlands

Rice fields and managed wetlands in the region provide wintering habitat for large numbers of waterfowl and shorebirds. Central Valley wetlands are part of the Pacific Flyway and many rice farmers flood their fields during the winter when Central Valley ricelands provide habitat for about seven million waterfowl and several hundred thousand shorebirds and wading birds (Petrie and Petrik 2010). In fact, Central Valley ricelands support 230 wildlife species, including the federally-listed threatened giant garter snake (*Thamnophis gigas*). Giant garter snakes need standing water with emergent vegetation to support their prey animals, such as frogs and fish. Although they occur in rice fields, they are most frequently found in vegetated canals and ditches that are associated with the rice fields. Wetlands in the region also support the state-listed threatened California black rail (*Laterallus jamaicensis coturniculus*).

2.4.3 Field and Hay Crops, and Grasslands

Field crops, hay crops, and grasslands in the region provide foraging habitat for raptors, including the Swainson's hawk (*Buteo swainsoni*), listed as threatened by the state, and the white-tailed kite (*Elanus leucurus*), which is listed as fully protected by the state, as well as several other raptor species. Alfalfa and pastures provide year-round foraging habitat, while annual row crops provide a seasonal pulse of foraging habitat for these species. Corn fields where some portion of cobs remains on the field after harvest provide valuable foraging habitat for waterfowl species.

2.4.4 Riparian Habitat

Riparian habitat consists of trees and shrubs that typically occur along the banks of streams, such as willows, cottonwoods, and elderberries. It supports several protected species such as raptors that nest in trees, including the Swainson's hawk and white-tailed kite, but also species that nest in shrubs, such as the yellow-breasted chat (*Icteria virens*), which is considered a species of special concern by the California Department of Fish and Wildlife. Elderberry shrubs in the riparian habitat of the region support the valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*), which is listed as threatened by the federal government, but was proposed for removal from the Threatened and Endangered Species List in 2012.

The state-listed threatened bank swallow (*Riparia riparia*) nests in colonies in holes in vertical eroding banks of rivers. It occurs in substantial but declining numbers in the banks of the Feather River. In 1987, 6,590 burrows were counted along the banks of the Feather River, but the estimate for 2012 was 2,320 burrows (Bank Swallow Technical Advisory Committee 2013). Active bank erosion has been much reduced along the Feather River. Although the river is assumed to have actively meandered across the landscape before the 1850s, since then the channel has mostly remained within its current alignment (Mulder [no date]). The hydraulic gold mining that occurred from the 1850s to 1884 caused a large amount of clay-rich debris to be deposited in the channel and on the floodplain, which is currently still present as a thick layer of fine, clay-rich “slickens” (as much as 20 feet thick in Marysville) (Mulder [no date]). After hydraulic mining was stopped in 1894, the sediment load gradually diminished and the river gradually entrenched into the mining debris. After 1969, when Oroville Dam was completed, sediment supply to the mainstem river was further reduced. Between 1909 and 1997, the thalweg of the river lowered an average of five feet in the area upstream of Gridley to almost 25 feet in the reach below Yuba City. The entrenchment of the river and thick layers of slickens along the banks makes restoring natural geomorphic processes (e.g., meandering) along the river difficult.

2.4.5 Riverine Aquatic Habitat

The Feather and Yuba Rivers support assemblages of native and introduced fish species, including several anadromous fish species that spawn in these rivers, but spend most of their life-cycle in the Pacific Ocean. Central Valley fall and late-fall run Chinook salmon (*Oncorhynchus tshawytscha*), are a federal species of concern. Most fall run Chinook arrive in the Feather and Yuba Rivers from mid-October through November, and spawn in these rivers from October through December. Juveniles migrate out of the system from January through June.

Spring run Chinook salmon spawn in the Feather and Yuba Rivers and are listed as threatened under the federal and California Endangered Species Acts. This includes the fish from the Feather River Hatchery Spring Run Chinook program. Spring run enter the Feather River from mid-April to mid-June and hold in the Low Flow Channel below Oroville Dam and the lower portion of the Yuba River through summer. Juveniles emigrate from the system from mid-November through June.

Central Valley steelhead trout (*Oncorhynchus mykiss*) are listed as threatened under the federal Endangered Species Act. Adults enter the Feather River in any month, but mostly in September and October, they typically spawn in the Feather and Yuba Rivers from December through April. Adults migrate back to the ocean after spawning, and juveniles rear in fresh water from 1 to 4 years (usually 2 years), then migrate to the ocean in the spring (March through June) (Moyle 2002). Steelhead in the Feather River are largely hatchery derived, but the Yuba River supports a persistent population of steelhead (NMFS 2009).

The region also supports the anadromous federally threatened green sturgeon (*Acipenser medirostris*) and Pacific lamprey (*Lampetra tridentada*), a federal species of concern, as well as other native species of concern such as Sacramento splittail (*Pogonichthys macrolepidotus*), hardhead (*Mylopharodon conocephalus*) and California roach (*Lavinia symmetricus* sp.). In addition, the commercially important anadromous introduced striped bass (*Morone saxatilis*) and American shad (*Alosa sapidissima*) occur in the Feather and Yuba Rivers.

Before 1850, the aquatic habitat of the Feather and Yuba Rivers provided a high diversity of habitats, with a variety of depths and velocities, and instream cover to harbor rearing juvenile

salmon and steelhead. At that time the river was likely still actively meandering, much like the middle reach of the Sacramento River between Red Bluff and Ord Ferry currently is. River banks would actively erode and trees would fall into the water, providing instream cover. However, as the result of entrenchment of the river into historical mining debris, and both sediment retention and flow regulation by major dams, the river channel is now relatively stable, trees do not fall into the river and riparian areas have grown up into dense forests that are encroaching into the channel. Passage for anadromous fish is also restricted on the Feather River at the Sunset Pumps Diversion Dam, which has impacted the survival for outmigrating salmonids and blocked green sturgeon upstream migration at certain flows). Passage for anadromous fish is restricted on the Yuba River by Daguerre Point Dam at flows greater than 2,000 cfs, and for green sturgeon at all flow levels. Although under current conditions it does not appear feasible to substantially restore geomorphic processes on the mainstem Feather and Yuba Rivers, aquatic habitat improvements have been made and more restoration actions can be implemented. For example, the Bear River Setback has restored active floodplain habitat that can be utilized by Sacramento splittail and rearing juvenile salmonids.

Table 2-2. Crop Types in the Floodways of Yuba, Butte and Sutter Counties

Crop Type	Acres
Yuba County	
Orchards (walnuts, prunes, plums, persimmons, peaches, citrus, cherries, apricots)	7,941
Vineyards/Kiwi	970
Rangeland	764
Wheat/Alfalfa/Hay	580
Butte County	
Orchards	781
Rice	119
Sutter County	
Orchards (walnuts, prunes, peaches)	1,647
Row Crops in the Sutter Bypass (corn, safflower, beans, orchard grass, rice, tomatoes, watermelons)	7,714
Total Acres Farmed in the Floodway	20,516

Source: Bozzo personal communication, February 2014

2.5 Historical Context

Prior to 1848, when the Gold Rush set off a huge, rapid influx of settlers, the region was occupied by Native American tribes, which lived by subsistence off of the abundant and diverse resources in the valley and foothills, including salmon, waterfowl, deer, elk, and acorns. The Native Americans adapted to the natural landscape and climate (Brewer, 1966), although records indicate that thousands died in a large flood at the beginning of the nineteenth century (USACE, 2011).

The low-lying portions of the valley were occupied by vast tule marshes, with riparian forests growing on the low, natural levees lining the meandering channels. At the higher elevations these marshes and riparian forests gave way to grasslands and oak woodlands (Brewer, 1966).

With its Mediterranean climate, the region is characterized by a well-defined cool wet season lasting generally from October through April, followed by a hot dry summer. With the Sierra Nevada Mountains to the east, and the exposure to the influence of storms sweeping in from the Pacific Ocean, the region can be subjected to rapid, extreme, and persistent flooding. The watersheds of the Feather, Yuba, and Bear rivers are capable of generating extreme peak flows when warm Pacific storms sweep in from the southwest, with high winds and ample moisture and release torrential rains as they are lifted over the mountains (Kelley, 1989), especially when combined with large snowmelt volumes from the Sierra Nevada Mountains.

Large floods were frequent in the nineteenth century, with high water events recorded for the Sacramento Valley in 1850, 1852, 1853, 1861-62, 1866-67, 1868, 1872, 1873, 1875, 1881, 1889, and 1892-93 (Kelley, 1989). Large floods have continued into the twentieth century as well, including 1902, 1907, and 1909, 1928, 1937, 1940, 1942, 1950, 1955, 1964, 1986, and 1997 (Thompson, 1989 and USACE, 2011). The flood of 2006 so far has been the only event in the twenty first century.

European settlement began in the region around 1850 with the development of highly productive farms in the Marysville-Yuba City area. After the devastating floods of 1852 and 1853, the people of Marysville and surrounding areas adjacent to the Feather and Yuba rivers began to build levees to protect their property from future flood events (USACE, 2011).

By the spring of 1867 a privately constructed levee extended along the west bank of the Feather River from its mouth to Star Bend, a distance of seven miles. Following flooding in April 1867 the people of Yuba City and the Sutter Basin determined to close off Gilsizer Slough and other overflow channels to the basin by constructing a levee from there to Star Bend, a distance of 20 miles (Kelley, 1989). The partially completed levee, constructed of mounded dirt, was breached by floodwaters in December of the same year. This set the pattern for the following decades, wherein the levee system was incrementally improved, yet inadequate to reliably hold back the enormous flows emanating from the Feather, Yuba, and Bear rivers.

The flood threat was greatly exacerbated by hydraulic mining, which sent millions of cubic yards of gravel, sand, and clay downstream to choke the channels of the Feather, Yuba and Bear rivers, and spread deep layers of sterile sediment over the fertile floodplains adjacent to the river channels where they emerged from the foothills. The hydraulic mining, which began in 1853 near Nevada City, rapidly expanded to include Mother Lode gravels along much of the central Sierra Nevada. It was largely halted as a result of the Woodruff vs. North Bloomfield decision, rendered in 1884 (Kelley, 1989, Rohe 1985).

In 1893, Congress passed the Caminetti Act, which created the California Debris Commission (CDC) and allowed hydraulic mining to resume as long as the mining debris could be contained at or near the mine sites. Crib dams constructed for this purpose proved unreliable, and much of the infrastructure to support hydraulic mining had been destroyed in the flood of 1891, so hydraulic mining activity did not resume on a large scale (Kelley, 1989).

The CDC, which was eventually consolidated with USACE, constructed three important mining debris retention dams, including Dagerre Point Dam on the Yuba River about 11 miles

upstream from Marysville in 1906 and Englebright Dam on the Middle Fork of the Yuba River near Smartsville in 1941 (USACE, 2012). It also isolated the vast hydraulic mining debris fields from the main Yuba River channel by contracting with gold dredgers to dredge the main channel and construct gravel training walls (Kelley, 1989).

The Jackson Plan, a comprehensive plan for flood protection for the Sacramento Valley, was proposed by USACE in 1910. Based on the flows recorded in the floods of 1907 and 1909, the plan relied on a system of levees along existing streams, supplemented by overflow weirs and bypasses to convey excess flood flows. The State Reclamation Board (renamed the Central Valley Flood Protection Board in 2007) was created the next year to carry out the plan, subsequently supported by the federal authorization of the Sacramento River Flood Control Project (SRFCP) in 1917 (CVFPB, 2012). The State and federally authorized SRFCP, which was substantially completed by 1958, includes the levees along the Sacramento River, the Feather River, Yuba River, Bear River, Cherokee Canal, the Sutter Bypass, and Wadsworth Canal (and the West Intercepting Canal and East Intercepting Canal, which feed into it).

As described by the Yuba County Water Agency (Be Prepared Yuba, 2013), multiple levee failures since the 1800s put residents and the communities at grave risk.

In 1950, the mining interests constructed a barrier across the low flow channel of the Yuba River to divert flows so the main channel could be mined. An early season flood caught the miners unprepared and on November 21, 1950, the south bank of the Yuba River broke near the town of Hammonton, inundating 43,200 acres, flooding the town of Hammonton and also inundating portions of southern Yuba County, causing over \$4 million (in 1950 dollars) in damage (USACE 2011).

In 1955, as every watershed in California was hit by tropical storms, the Yuba became a raging torrent that choked its mountain channel, poured over the dams at Bullards Bar and Englebright Reservoir, and ripped into the valley. The December 1955 flood was the most damaging flood recorded to date, based on loss of lives and damages. The peak flows of the Feather River and the Yuba River arrived at Marysville simultaneously, with the Feather River peaking at an estimated 180,000 cfs and the Yuba River peaking at 155,000 cfs. There was no upstream storage for flood waters on either the Feather or the Yuba at this time. The Feather River levee at Yuba City broke on the right bank about two miles downstream of the mouth of the Yuba River at Shanghai Bend. The left-bank levee of the Feather River also broke near Nicolaus. Marysville's levees were threatened, but held. About 100,000 acres of land were inundated, including 95 percent of Yuba City. Thirty-eight people were killed in the Yuba City area, and two were killed in the Nicolaus area. About 3,300 homes were flooded; 6,000 cattle were killed; and more than 30,000 people were evacuated. Flood damage was estimated at \$50.5 million (in 1955 dollars). The flooded communities were disrupted for several months (USACE 2011).

DWR constructed Oroville Dam and Lake in the period 1964 to 1967 as part of the massive State Water Project (SWP). Despite being partially completed, Oroville Dam helped control the flood of December 1964, limiting damage in the region. During the December 1964 flood, the peak inflow into the nearly completed Lake Oroville was 253,000 cfs. Outflow from the partially constructed Oroville Dam was reduced to 158,000 cfs. Peak flows on the Yuba River reached 180,000 cfs and encroached into the levee freeboard. The flood inundated about 25,000 acres of agricultural land in the Feather River floodway and within the Yuba River levees, causing damages of about \$5 million (in 1964 dollars). Flood storage in the Lake Oroville reduced the

flow in the Feather River when the Yuba River peaked, which reduced the combined flows from the Feather and Yuba Rivers downstream of the confluence. As a result, the upstream backwater effect and the downstream peak flows were reduced.

In response to the 1955 flood, the State Legislature created the Yuba County Water Agency in 1959, which, in cooperation with USACE and the State, constructed the multipurpose New Bullards Bar Dam and Reservoir. In large part financed by local revenue bonds, the dam construction began in 1966 and was completed in 1969. It provides up to 170,000 acre-feet (AF) of flood control storage October 31 through March 31 of each year.

The February 1986 flood was created by an intense and persistent storm system, characterized by a rapidly moving, warm, moist stream of air from the subtropics, which carried a series of large, closely spaced rain storms into Northern California. Peak flows on the Yuba River during the February 1986 flood were about 111,900 cfs. Oroville Lake on the Feather River received peak inflows of 198,900 cfs and made controlled releases of 147,400 cfs. There was little time between storms to make releases to regain flood storage space. Both Lake Oroville and New Bullards Bar reservoirs were almost filled to flood storage capacity and nearly had to make releases of total inflow. On February 20, 1986, while the Feather River and Yuba River were receding, a section of the Yuba River left-bank levee failed just upstream of the Feather River (USACE 2011).

Water quickly inundated the towns of Linda and Olivehurst. More than 3,000 homes were damaged and 895 were destroyed. Flood waters were 10 feet (FT) high in some places. Losses were estimated at \$22 million. In the years immediately following, millions were spent by USACE and DWR to improve the area's levees and correct problems.

The January 1997 flood was probably the largest in northern California since measured records began in 1906. The flood was notable in the sustained intensity of rainfall, volume of floodwater, and areal extent – from the Oregon border to the southern end of the Sierra Nevada. New flood records were set on many of the major Central Valley Rivers. Over the 3-day period around New Year's Day, warm moist winds from the southwest blowing over the Sierra Nevada poured more than 30 inches of rain onto watersheds that were already saturated by one of the wettest Decembers on record. Most of the large dams in northern California were full or nearly full within the first days in January.

The Feather River east levee failed near the community of Arboga on January 2, 1997, prompting the evacuation of about 15,000 people from Linda and Olivehurst. Homes closest to the breaks were destroyed by the force of the rushing water, with some reports indicating flood depths of 30 feet. Farther from the levee breaks, many homes were damaged beyond repair due to water depths of 10 feet (Be Prepared Yuba, 2013). Three people lost their lives, and nearly 50,000 inhabitants of Yuba City, Marysville, and surrounding areas were evacuated because of fears over possible additional levee breaks. Two relief cuts were made in the Feather River levee further downstream of the levee break to drain the floodwaters accumulating in the southern portion of Reclamation District 784 (RD 784). Two additional breaks occurred on the right bank levee of the Bear River near the Highway 70 Bridge, which aided in draining the floodwater (USACE 2011).

Portions of the communities are still trying to recover today, more than 16 years after the 1997 flood. In the course of the flood; 1,000 acres of residential land, 15,500 acres of agricultural land, and 1,700 acres of industrial land were flooded. Over 300 homes (322) homes were

destroyed and 407 suffered major damage. The estimated cost of the flooding exceeded \$300 million in 1997 dollars (Be Prepared Yuba 2013).

The Gulf Coast devastation caused by Hurricane Katrina in 2005, particularly the flooding of New Orleans, brought into sharp focus the need for improved flood protection in California. Proposition 1E and Proposition 84, approved by California voters in November 2006; authorize the State to expend about \$5 billion in bond funds for improved flood protection. As a result, DWR has been able to substantially accelerate flood risk reduction projects, launch the FloodSAFE California (FloodSAFE) initiative, and implement numerous improvements in California flood management. Local agencies have once again taken a leadership role in formulating and executing flood protection for major urban centers in the Central Valley, including the Sacramento Area Flood Control Agency (SAFCA), the Three Rivers Levee Improvement Authority, and the Sutter Butte Flood Control Agency.

2.6 The Regional Flood Management System

2.6.1 Structural Elements

The flood management system which currently provides protection to the Feather River Region includes upstream reservoirs with active flood control space, levees along the major watercourses acting as flood control channels during high water events, and drainage facilities which pump interior runoff and seepage from levee protected areas back into the flood control channels. It is part of a vast system of multipurpose reservoirs, leveed stream channels, weirs, and overflow structures which has been constructed to reduce flooding in the Sacramento Valley over the past 160 years. These facilities comprised the State Plan of Flood Control for the Sacramento River Basin and are illustrated on Figure 2-2.

Reservoirs in the region with an active flood control function include Lake Oroville on the Feather River, operated by DWR, and New Bullards Bar Reservoir, on the Yuba River, operated by YCWA. Camp Far West Reservoir on the Bear River, operated by South Sutter Water District, does not provide any dedicated flood control storage and is typically full and spilling during flood events. However, the existence of the water supply facility does serve to attenuate a portion of the peak flow as it passes through the surcharged reservoir.

SPFC levees line the Cherokee Canal north of the Sutter Buttes, the Feather River downstream of Thermalito Reservoir, the perimeter of Marysville, the Yuba River north of the Yuba Goldfields, the lower Bear River, Yankee Slough, the Western Pacific Interceptor Canal, the Sutter Bypass, and Wadsworth Canal, (and the West Intercepting Canal and East Intercepting Canal that feed into it) and the Natomas Cross Canal (see Figure 2-2)

2.6.2 Operational Elements

The flood management system is operated to safely convey flood flows, through the coordinated efforts of local, State, and federal agencies. Flood control system operations include the operation and maintenance of the multipurpose reservoirs protecting the region; operating and maintaining the levee system; hydrologic monitoring and flood forecasting, and coordinated flood operations under the Standardized Emergency Management System (SEMS).

Under SEMS, the LMAs are responsible for patrolling their levee systems during high water events, initiating flood fights where necessary, and requesting assistance from their respective Operational Areas. Each county in the region is organized as an Operational Area for emergency

purposes to provide supplies, logistical support, and technical support to the LMAs, and when their resources are exhausted, can request assistance from the Cal OES Inland Regional Operations Center in Rancho Cordova, which can in turn request additional flood fight support from the DWR Flood Operations Center (FOC). The FOC responds to these requests for assistance by allocating available State emergency supplies, crews, and technical support staff, and if State resources are exhausted, request emergency PL 84-99 support from USACE.

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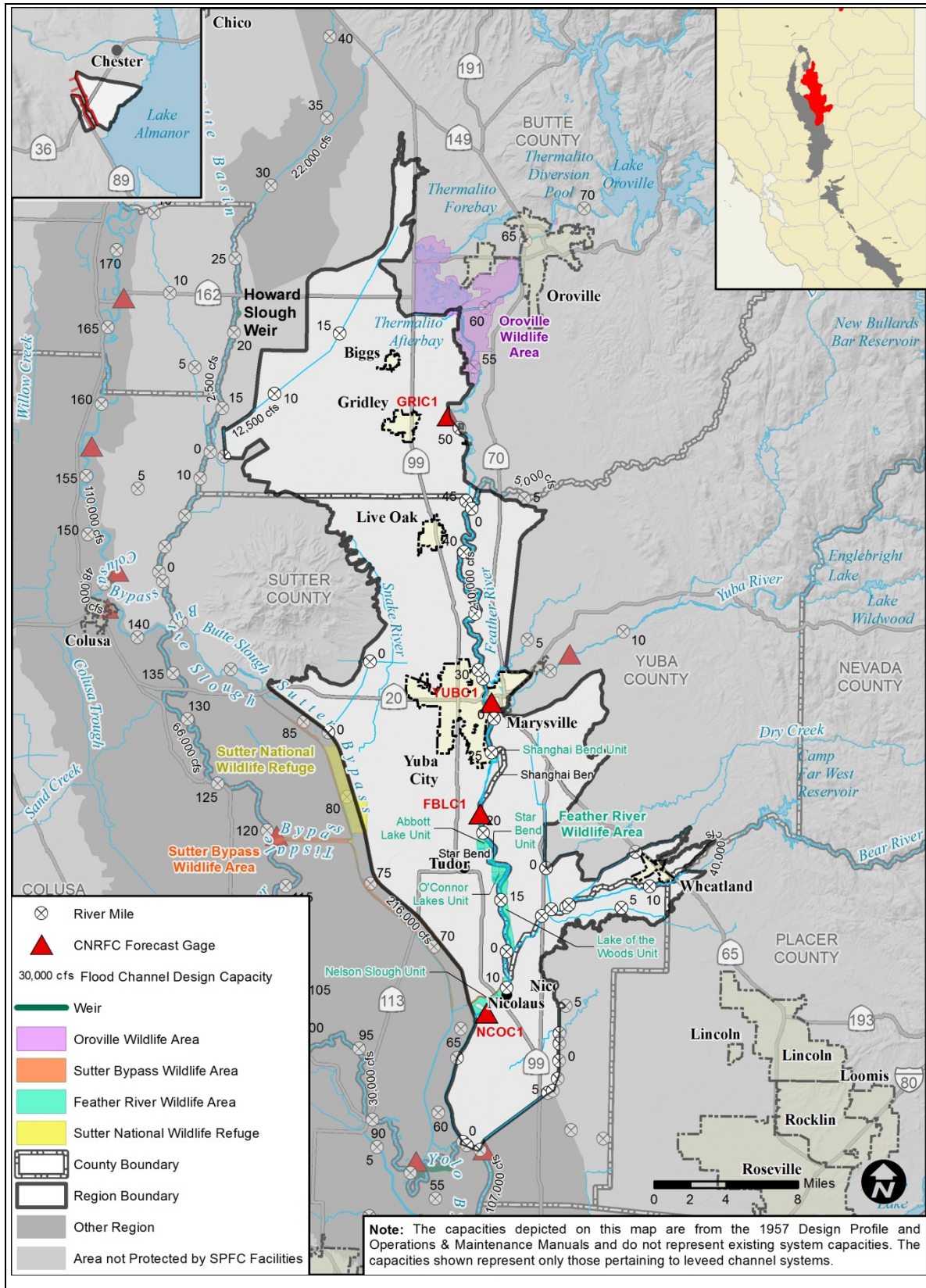


Figure 2-1b. Wildlife Areas in the Region

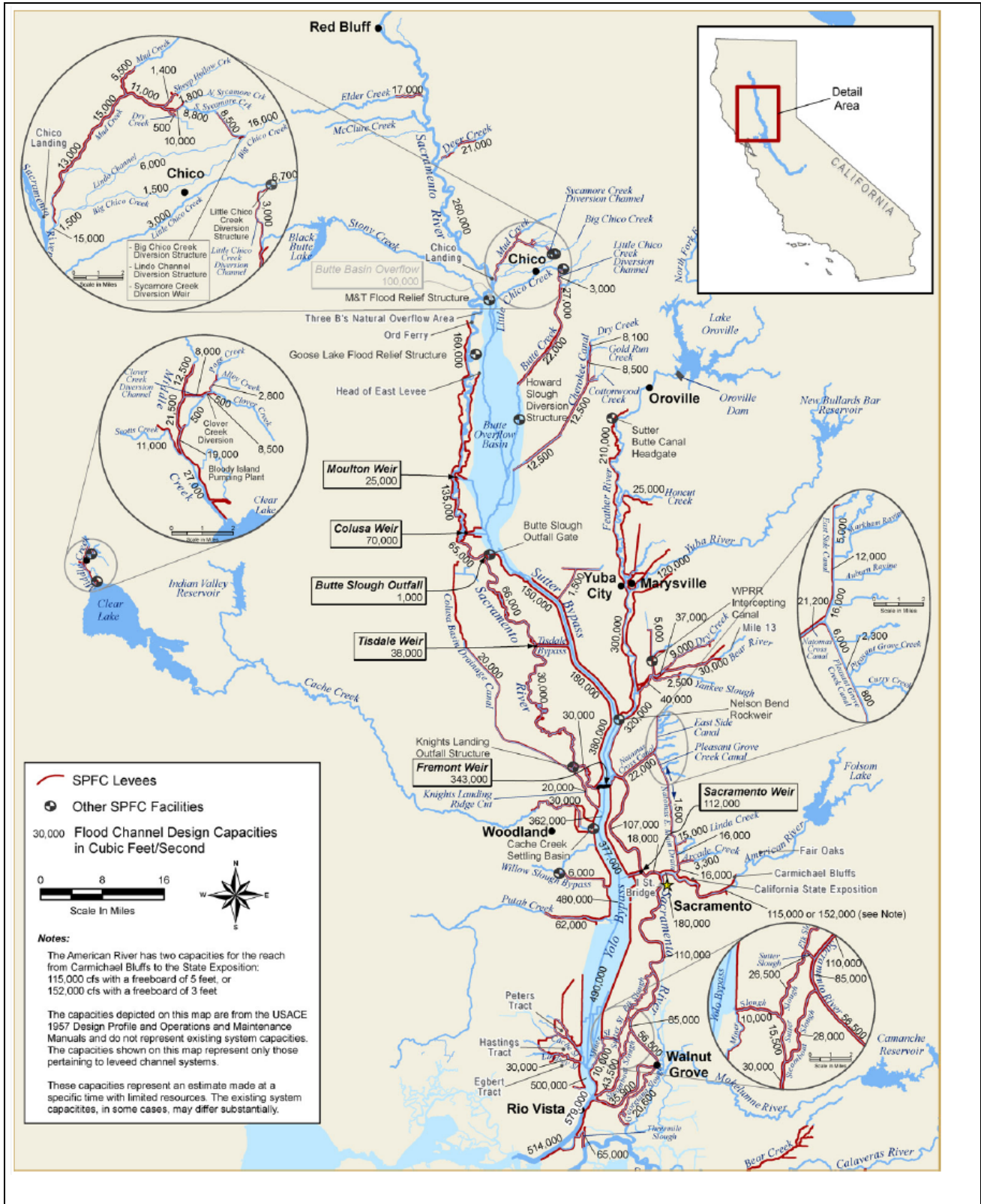


Figure 2-2 State Plan of Flood Control Facilities, Sacramento River Basin (DWR 2011)

2.6.3 Non-Structural Elements

Non-structural flood risk management elements include a wide range of measures that limit the risk of flood damage primarily by avoiding or reducing the exposure to damaging flood waters rather than by confining those flood waters with larger and stronger hydraulic structures. These elements include raising and waterproofing structures so that they will be above anticipated flood levels or unharmed by flood waters, purchasing and relocating at-risk structures, limiting development in floodplains through the acquisition of agricultural and habitat conservation easements, establishing open space easements, regulatory constraints, and incentive programs. Restoration of floodplains where feasible, to provide additional flood channel storage and conveyance capacity, is often regarded as a non-structural element because it reduces, rather than increases, the confinement of floodwaters in existing channels.

The most significant non-structural flood risk reduction program is the Federal Emergency Management Agency (FEMA) National Flood Insurance Program (NFIP), which includes mapping flood hazard areas nationwide, and requiring that homes and other structures with federally backed mortgages must carry flood insurance if the flood risks warrant it, and by requiring minimum construction standards within the floodplain.

In recent years FEMA, DWR, and USACE have worked as mapping partners to update the flood risk maps for the region. The map revision process has taken place at the same time as standards for levee integrity have been substantially raised, with the result that large portions of the regional levee system have lost, or will lose, their 100-year flood protection certifications and the lands they protect will be mapped into the 100-year floodplain.

The regulatory framework of the NFIP is intended to limit the life, safety, and economic impacts of flooding, but may also have unintended economic impacts on farms, which may be prevented from upgrading structures and equipment to stay competitive, or rebuilding after a flood.

Therefore revisions to the NFIP regulatory framework are among the potential nonstructural flood risk management options considered in this report.

Senate Bill 5 and companion legislation passed by the State Legislature in October 2007 established flood protection requirements for urban areas and small communities and require that further floodplain development be accompanied by appropriate levels of flood protection.

Hazard mitigation planning is an important non-structural flood risk management tool, particularly with regard to public safety. It includes local, regional, State, and federal efforts to promote an awareness of flood risk, planning emergency response actions such as evacuations, stockpiling supplies and equipment, conducting training exercises, and improving notification and communication capabilities. The counties in the region have all participated in the hazard mitigation planning prompted by the federal Disaster Mitigation Act of 2000, with federal and State grant support. Local agencies must have official Hazard Mitigation Plan (HMP) in order to qualify for FEMA disaster assistance. As a result, each county, and many of the local agencies with emergency response capabilities within each county, have identified hazards and ways to prevent or mitigate their impacts, documented in multi-jurisdictional, multi-hazard plans.

2.6.4 Involved Local, State, and Federal Agencies

Historically, major flood management initiatives in California have been undertaken by local, State, and federal agencies in an evolving cooperative relationship. Beginning in the 1850s,

levee improvements were initiated as entirely local undertakings, with sporadic efforts to provide State coordination and oversight.

State oversight of flood control efforts in the Sacramento Valley began in 1911, with the creation of the Central Valley Flood Protection Board (formerly the State Reclamation Board). Federal participation in California flood management, which was first authorized in the Caminetti Act of 1893, was firmly established with authorization of the Sacramento River Flood Control Project in 1917. From 1917 to 2006 USACE has played a lead role in planning, authorizing, financing, constructing, and inspecting flood system improvements in the Sacramento Valley, incorporating and improving upon the levee system originally constructed by local agencies (Kelley, 1989).

Since 2006, DWR and local agencies have played more prominent roles, providing leadership on major levee improvement projects in the region. The various roles of the involved agencies can be expected to continue to shift in response to political and policy changes, funding availability, interest, and leadership. The roles of the key local, State, and federal agencies involved in providing and permitting flood management projects and programs are summarized below.

2.6.4.1 Local Agencies and their Responsibilities

Local agencies play a key role in providing flood protection for the region as described below.

Yuba County Water Agency

The Yuba County Water Agency operates New Bullards Bar Dam and Reservoir for flood control, water conservation, and power generation. Since its creation in 1959 the agency has played a strong leadership role in enhancing regional flood protection. In addition to operating New Bullards Bar Dam and Reservoir, it has provided planning support and funding for levee improvement projects in Yuba County. YCWA does not have any involvement in designing, constructing, or maintaining any levee systems.

South Sutter Water District

Camp Far West Irrigation District was created in 1924 to construct Camp Far West reservoir and distribute its waters for irrigation. In 1954, the South Sutter Water District was created and subsequently joined with the Camp Far West Irrigation District to construct and operate the New Camp Far West Reservoir, with a capacity of 104,000 acre feet and 7 megawatts of generating capacity. It was completed in 1964 (SWRCB, 1958). In addition to its primary functions of providing irrigation water and generating electricity, the facility also provides a minor amount of flood peak attenuation through reservoir surcharge.

Levee Maintaining Agencies (LMAs)

Local levee districts, reclamation districts, and State maintenance areas, known collectively as Levee Maintaining Agencies (LMAs) regularly patrol, maintain, repair, and conduct flood fights as needed on the levees within their jurisdictions. The LMAs have given assurances to the CVFPB that they will operate and maintain the Project levees within their respective jurisdictions (see Table 2-3 and Figure 2-3) in perpetuity in accordance with criteria established by USACE. O&M work for the flood control system is conducted under Title 23 of the California Code of Regulations. The LMAs conduct O&M activities in their respective jurisdictions in accordance with the *Standard Operation and Maintenance Manual for the Sacramento River Flood Control Project* (USACE 1955a). Additional project (unit-specific) O&M manuals supplement USACE's standard O&M manual for specific units of the flood

control system (e.g., individual segments of a levee, pumping plant, weir, or bypass). These manuals describe each agency's responsibilities for inspection and operation under high-water conditions and their ongoing maintenance responsibilities for sustaining the flood control system's function.

Several agencies are responsible for O&M of distinct units of land in the study area:

- LD 1 maintains levees along the right (west) bank of the Lower Feather River in Sutter County from north of Yuba City to approximately 5 miles north of the confluence with Sutter Bypass; the lowermost 5 miles of the right-bank levees are maintained by the State (Maintenance Area 3).
- LD 9 maintains 6.24 miles of Feather River right bank levee between MA 16 to the north and LD1 to the south.
- RD 10 maintains the Feather River left bank levee between Honcut Creek and Jack Slough, north of Marysville, the south bank of Honcut Creek, the north bank of Jack Slough, and along the Western Pacific Railroad embankment which creates the eastern boundary of the district, for a total of 21.93 miles.
- RD 784 maintains levees along the left (south) bank of the Yuba River, the left (east) bank of the Feather River between the Yuba and Bear rivers, and the right (north) bank of the Bear River; this includes maintaining all levees improved by TRLIA as specified in a memorandum of understanding. RD 784 also maintains drainage facilities and pumping stations associated with these levees and portions of the Feather River setback area. It also maintains the levees of the Horseshoe area, east of the Western Interceptor Canal and north of the Bear River and Cry Creek. RD 784 maintains a total of 38.43 miles of levees.
- RD 817 Maintains the western portion of the levee system protecting the mostly agricultural land west of the City of Wheatland (west of Oakley Avenue), as well as a 1.3 mile section of levee on the north (right bank of Dry Creek from just upstream of Forty-Mile Road downstream to the confluence of Dry Creek with the Bear River. It maintains a total of 9.19 miles of levees.
- RD 1001 maintains the levees along the left (south) bank of the Bear River and the left (east) bank of the Feather River from the Bear River to the Sutter Bypass, and continuing southward along the Feather and Sacramento rivers to the Natomas Cross Canal, the Natomas Cross Canal north levee, and the drainage training levees on the eastern boundary of the district, for a total of 44.03 miles.
- RD 2103 maintains the levees protecting most of the City of Wheatland, including the right bank (north) levee of the Bear River and the left bank (south) levee of Dry Creek, for a total of 9.77 miles.
- The Marysville Levee District (MLD), under the jurisdiction of the Marysville Levee Commission, maintains the levee system which entirely surrounds the City of Marysville, including the south levee along Jack Slough (also the Western Pacific Railroad and Southern Pacific Railroad embankment, the east levee of the Feather River, the right (north) bank of the Yuba River, and about 1.5 miles of the back levee on the eastern boundary of the city between Jack Slough and the Yuba River, for a total of 11.3 miles.

- TRLIA manages floodway capacity and restoration and mitigation areas within the Bear River setback area and portions of the Feather River setback area (River Partners 2006; TRLIA 2010c).
- As part of its many flood management responsibilities, DWR also functions much like a LMA in the region, with responsibilities for specific portions of the regional levee system, channels, pump stations, and other infrastructure, including MA 3, MA7, MA 13, and MA 16. These are described in Section 2.6.4.2

Regional Agencies and Their Responsibilities

Two regional flood management agencies have been created to improve flood protection for the region over the past nine years.

TRLIA, a joint powers agency, was established in May 2004 by the County of Yuba and Reclamation District 784 to finance and construct levee improvements in south Yuba County. TRLIA's mission is to provide 200-year flood protection to the Three Rivers area, bounded on the north by the Yuba River, on the west by the Feather River, on the south by the Bear River, and the southeast by the Western Pacific Interceptor Canal (WPIC) levee. (TRLIA, 2013).

The Sutter-Butte Flood Control Agency, a joint powers agency formed in 2007 by the counties of Butte and Sutter; the cities of Biggs, Gridley, Live Oak, and Yuba City; and Levee Districts 1 and 9. The agency has the authority to finance and construct regional levee improvements. It is currently working to improve the levees protecting the Sutter Basin, with the initial phases of work focused on the Feather River east levee (SBFCA, 2013).

2.6.4.2 Relevant State Agencies and their Responsibilities

The local agencies are supported in their flood management missions by eight key State agencies (See Table 2-3 and Figure 2-3).

Central Valley Flood Protection Board (CVFPB)

The CVFPB was created in 1911 to provide coherent State oversight over flood control projects along the Sacramento and San Joaquin rivers and their tributaries in cooperation with the USACE. Since then it has cooperated with various agencies of federal, State, and local governments in establishing, planning, constructing, operating, and maintaining flood control works. Foremost among those planning and implementation partners is DWR, which, as described below, cooperates with the Board and USACE on project planning, funding, construction, operation, maintenance, enforcement, and emergency operations.

The CVFPB exerts regulatory authority over the SPFC levees and the channels between them (Title 23, Division 1 of the California Code of Regulations). It serves as the non-federal sponsor for federally authorized capital improvement flood control projects in the region and provides assurances to USACE that these projects will be operated and maintained in accordance with federal requirements, regulates encroachments, and works to ensure that the various components function as a system. It has designated over 1,300 miles of floodways throughout the Central Valley and continues to administer them to ensure their continued flood carrying capacity.

Table 2-3. Local Maintaining Agencies for State Plan of Flood Control Levees in the Feather River Region

Local Maintaining Agency	County	Stream³	Miles²
Levee District No. 1	Sutter	Feather River RB	16.65
Levee District No 9	Sutter	Feather River RB	6.24
Reclamation District No. 10, Honcut	Yuba	Feather River and Honcut Creek	23.4
Reclamation District 784, Plumas Lake	Yuba	Yuba River LB, Feather River LB, Bear River RB, and Western Pacific Interceptor Canal, plus 60 miles of ditches, canals, detention basins	38.43
Reclamation District 817, Carlin	Yuba and Sutter	Bear River RB and Dry Creek	9.19
Reclamation District 1001, Nicolaus	Sutter	Bear River LB, Yankee Slough LB and RB, Feather River LB, and Natomas Cross Canal	44.03
Reclamation District 2103, Wheatland Vicinity	Yuba	Bear River RB and Dry Creek LB	9.77
Marysville Levee District	Yuba	Feather River LB, Yuba River RB, and Jack Slough LB	11.38
DWR Maintenance Area 3 ¹	Sutter	Feather River RB and Sutter Bypass LB	5.19
DWR Maintenance Area 7 ¹	Butte and Sutter	Feather River, RB	12.07
DWR Maintenance Area 13 ¹	Butte	Cherokee Canal, LB, RB, and channel	41.97
DWR Maintenance Area 16 ¹	Sutter	Feather River, RB	4.09

¹ Maintenance provided by the Sutter Maintenance Yard, DWR

² DWR 2010 Inspection Report of the Central Valley State-Federal Flood Protection System

³ LB= left bank, RB=right bank, when looking downstream in direction of flow

California Department of Water Resources (DWR)

DWR, primarily acting through its Division of Flood Management (DFM), is responsible for State-level flood management in the region, including cooperating with USACE in project planning, design, funding and construction; cooperating with the National Ocean and Atmospheric Administration (NOAA) in flood and water supply forecasting, operating the Flood Operations Center, providing flood fight assistance for local agencies, and maintaining portions of the system.

DWR's levee maintenance responsibilities include levees and floodway channels of the system designated for State maintenance in the California Water Code (CWC §8361(f)). Maintenance work is performed by the DWR Sutter Maintenance Yard, with its corporation yard and offices in the town of Sutter, on Highway 20. It is required to maintain the East and West Interceptor canals (3 miles), the Wadsworth Canal (5 miles), the Sutter Bypass east levee (22 miles), and the three major pump stations draining the Sutter Basin. In all, Sutter Yard maintains a total of 92 miles of levees within the region.

It has overall responsible for maintaining flood carrying capacity in all river channels in the region. This includes 1,505 acres within Cherokee Canal, 20,849 acres within the Feather River floodway, 7,489 acres within the Yuba River floodway, 597 acres within the Western Pacific Railroad Intercepting Canal channel, 2,760 acres within the Bear River floodway, and 115 acres within the Bear River floodway. It also includes maintaining drainage structures and bridges (debris removal) within the Sutter Bypass, the Nelson Slough rock weir and training levee at the confluence of the Sutter Bypass and the Feather River, and routine maintenance to manage

floodway capacity on some CDFW lands (O'Connor Lakes and Lake of the Woods) in the lower Feather river. In total, the Sutter Yard maintains 33,315 acres of floodway within the region.

Sutter Yard also operates four Maintenance Areas (MAs) when local agencies cannot, or choose not to, meet the levee maintenance obligations established under the assurances given to the CVFPB and USACE (CWC §12878 et. seq.). Under these authorities the DWR Sutter Maintenance Yard maintains MA-3, 7, 13, and 16. MA 3, 7, and 16 are located along the Feather River, while MA 13 includes the entire levee system for the Cherokee Canal. Table 2-3 lists the levee miles within each MA maintained by Sutter Yard.

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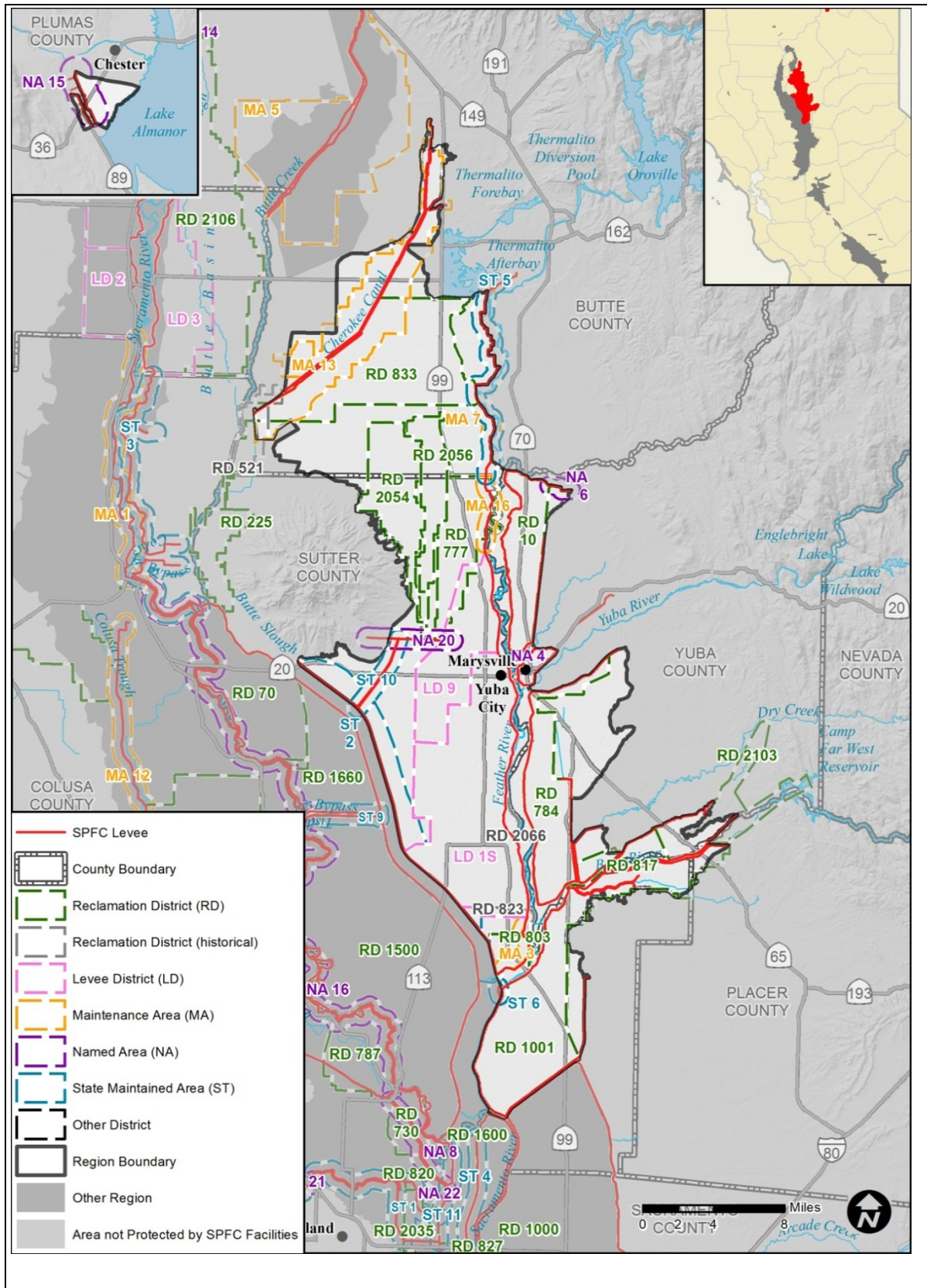


Figure 2-3. Levee Maintaining Agencies, Districts, and State Maintenance Areas

Oroville Dam and Reservoir, completed in 1967, are operated by DWR's Division of Operation and Maintenance (O&M) in accordance with criteria established by USACE.

California Office of Emergency Services (Cal OES)

The California Office of Emergency Services (Cal OES) has overall State emergency response management authority, which among other things, includes ensuring that State and local agencies operate in accordance with SEMS. OES works with FEMA to secure federal funding to assist the State and local agencies in recovering from national disasters.

California Department of Fish and Wildlife (CDFW)

The California Department of Fish and Wildlife (CDFW) administers State laws and regulations regarding the protection of fish and wildlife resources, as well as the Fish and Game Code 1600 protecting all lakes, streambeds and riparian habitat and as such exerts permitting authority over flood control project construction, operation, and maintenance activities, as well as managing State wildlife areas in the region.

State Water Resources Control Board (SWRCB) and the Regional Water Quality Control Board, Central Valley Region (RWQCB)

The State Water Resources Control Board (SWRCB) and the California Regional Water Quality Control Board, Central Valley Region (CRWQCB-CVR), administer State water rights and water quality laws and regulations. The SWRCB, given its authority over water rights, including stream diversions, may exert regulatory authority over flood control or environmental restoration projects that result in new diversions from existing channels. The CRWQCB requires that construction projects, such as levee improvement projects, avoid injurious discharges from worksites to streams by preparing and adhering to Storm Water Management Plans and following Best Management Practices for chemicals, diesel fuel, drilling fluid, and other typical construction fluids. The CRWQCB also works closely with USACE when it issues Section 404 permits, which must include a certification by the CRWQCB that water quality will not be impaired (Section 401 permit).

California Department of Conservation (DOC)

The California Department of Conservation (DOC) is responsible for administering the California Surface Mining and Reclamation Act (SMARA) of 1975. It ensures that local governments, such as cities and counties, adopt and administer ordinances compliant with the law. SMARA is an important consideration for most flood control projects, as it applies to any projects that disturb more than one acre of land or move more than 1,000 cubic yards of material. SMARA compliance involves formulating projects that do not result in injurious discharges from the disturbed area during the mining operation, followed by a reclamation plan that restores the mined land to beneficial use (DOC, 2013).

DOC also administers the Williamson Act, enacted in 1965, enables local governments to enter into contracts with private landowners for the purpose of restricting specific parcels of land to agricultural or open space use. In return, landowners receive property tax assessments that are much lower than normal because they are based upon farming and open space use as opposed to full market value. It was enhanced in 1998 with the addition of Farmland Security Zone (FSZ) provisions, which offers additional incentives to extend the contract period from the normal ten-year period to twenty years. Butte County, Sutter County, and Placer County participate in the

Williamson Act program. Placer County also participates in the FSZ provisions as well. Yuba County does not participate in the program. The DOC also administers various grant programs for the acquisition of agricultural and open space preservation (DOC, 2013). Such programs may work synergistically with non-structural flood management projects, which may improve flood system capacity, reduce long-term risks to life and property, and improve resiliency through actions such as agricultural conservation easements, open space easements, levee setbacks, and floodplain restoration where locally supported and feasible.

The California Air Resources Board (ARB)

The California Air Resources Board (ARB), established in 1967 with the passage of the Mulford-Carrell Act, has consistently set air quality standards for California that are more stringent than the national standards. It oversees 35 local and regional air pollution control districts, which are responsible for regulating air quality within their districts. Within the region, the Butte County Air Quality Maintenance District, the Feather River Air Quality Maintenance District, and the Placer County Air Pollution Control District regulate air quality. These districts review and exert permitting authority over flood control project construction activities. In practice, the primary constituents of concern are fugitive dust and diesel exhaust, which can be limited through the application of best management practices (Air Resources Board, 2013).

State Historic Preservation Office (SHPO)

The extensive ground disturbing activities associated with levee reconstruction may affect archaeological and cultural resources, which are protected by both federal and State law. The State Historic Preservation Office (SHPO) must approve construction activities which have the potential for disturbing such resources. Mitigation for the potential impacts on archaeological and cultural resources include pre-construction surveys, designing projects to avoid impacts where feasible, construction monitoring, and protection of such resources if discovered during the course of construction. It is very important to coordinate with the Most Likely Descendants (MLDs) of resources in the project area throughout the planning and construction process.

2.6.4.3 Federal Agencies and their Responsibilities

The local and State agencies are also supported in their flood management missions by six key federal agencies.

U.S. Army Corps of Engineers (USACE)

At the federal level, USACE is primarily responsible for planning, designing, and constructing federally authorized flood management facilities, including dams, levees, and other structures. It also develops the operational rules for federally funded flood control reservoirs, which includes most of the major reservoirs on Central Valley streams. Following the Hurricane Katrina Gulf Coast disaster of 2005, USACE implemented a National Levee Safety Program, promulgated strict vegetation management guidelines, and strengthened its national levee inspection program. The USACE also retains permitting authority through Sections 208.1 and 408 for modifications or improvements to Federal Project levees. The USACE has regulatory authority through Section 404 of the Clean Water Act for projects that discharge dredge or fill materials into navigable waters of the United States.

National Weather Service (NWS)

The National Weather Service (NWS), a part of the National Oceanic and Atmospheric Administration, operates centers throughout the United States that monitor and forecast climate, weather, severe storms, and runoff. In California, the NWS weather forecasting centers are supplemented by the California Nevada River Forecast Center (CNRFC), which cooperates with DWR to issue flood and water supply forecasts (CNRFC, 2013). These forecasts are critically important to the region, because under winter storm conditions, the Feather, Yuba, and Bear rivers can rapidly generate enormous flows, creating conditions of extreme peril for residents and damageable property in the levee-protected areas of the region. Accurate and timely flood forecasts are an important component of the region's flood risk management system.

National Oceanic and Atmospheric Administration, Fisheries (NOAA Fisheries)

NOAA Fisheries is responsible for the protection of anadromous fisheries, including salmon and steelhead, which migrate through and spawn in channels of the Feather, Yuba, and Bear rivers, as well as some local creeks. NOAA fisheries plays an important role in the flood project planning process, providing guidance on ways to design and operate flood control works to minimize impacts and enhance fisheries habitat. USACE and other project proponents must consult with NOAA fisheries in all phases of federal flood management project planning, design, and construction that have the potential for impacting the species of concern, which NOAA Fisheries administers. In administering various federal statutes and regulations protecting migratory species of concern, NOAA fisheries may also impose conditions on the operation of multipurpose dams and reservoirs with federal participation, including the major reservoirs protecting the region (NOAA Fisheries, 2013). USACE and other project proponents must consult with NOAA fisheries in all phases of federal flood management project planning, design, and construction.

U.S. Fish and Wildlife Service (USFWS)

The USFWS plays a similar role as that of NOAA Fisheries, with a focus on terrestrial, avian, and resident species and their habitats. In the region, some of the key species of concern are the Giant Garter Snake (GGS), and the valley elderberry longhorn beetle. USFWS plays an important role in the flood project planning process, providing guidance on ways to design and operate flood control works to minimize impacts and enhance fish and wildlife habitats. USACE and other project proponents must consult with USFWS in all phases of federal flood management project planning, design, and construction.

Federal Emergency Management Agency (FEMA)

The Federal Emergency Management Agency plays a multitude of flood management roles, including managing the National Flood Insurance Program, which includes mapping of and classification of flood hazards in the region. FEMA administers the Disaster Mitigation Act of 2000 (DMA, 2000), which requires that local communities evaluate the natural hazards within their boundaries and develop mitigation plans for those hazards in order to maintain eligibility for its Pre-Disaster Mitigation (PDM) and Hazard Mitigation Grant Programs (HMGP). FEMA also provides federal disaster recovery assistance in the event of federal emergency declarations or disaster declarations.

Federal emergency management efforts are structured in accordance with the National Incident Management System (NIMS), which was patterned after the SEMS system developed in California.

Federal Energy Regulatory Commission (FERC)

The Federal Energy Regulatory Commission (FERC) is an independent federal agency that regulates the interstate transmission of electricity, natural gas, and oil. It also reviews proposals to build liquefied natural gas terminals and interstate natural gas pipelines as well as licensing hydropower projects. Its licensing authority over hydroelectric projects extends to private, municipal, and State hydroelectric projects (FERC, 2013). All of the multipurpose dams in the region are licensed by FERC, including Oroville, New Bullards Bar, Englebright, and Camp Far West dams.

Oroville Dam and Reservoir

The Feather River Hydroelectric Project, a component of DWR's Oroville Dam and Reservoir complex, was originally licensed on February 11, 1957, for a period of 50 years. DWR began the relicensing application process in 2000, well ahead of the January 31, 2007 expiration date of the original license. DWR chose to follow the Alternative Licensing Process (ALP), designed to expedite the review and approval process. DWR conducted extensive outreach and negotiations with a broad range of stakeholders on a multitude of issues, while concurrently preparing an Environmental Impact Report/Environmental Impact Statement (EIR/EIS) and conducting technical studies in support of the process. DWR filed the application for a new or subsequent license on January 26, 2006. Shortly thereafter, on March 24, 2006 DWR and interested parties, including regional stakeholder groups, filed a Settlement Agreement that addressed a multitude of concerns related to environmental quality, recreation, cultural resources, flood control, and other issues (DWR, 2006). FERC granted the license on a one-year renewable basis on February 1, 2007. The license is renewed automatically unless FERC orders otherwise (FERC, 2007). From a flood management perspective, an important outcome was the determination that USACE, rather than FERC, would continue to set the rules and regulations for flood operations at the facility.

New Bullards Dam and Reservoir

Similarly, YCWA is in the process of relicensing the Yuba River Development Project which includes the New Bullards Bar Dam and Reservoir. The initial FERC license for the Project expires April 30, 2016. YCWA applied to FERC for a new license (Relicensing) using FERC's Integrated Licensing Process (ILP), as described in Title 18 of the Code of Federal Regulations (CFR), Subchapter B, Part 5. Consistent with these regulations, YCWA filed its Final License Application on April 28, 2014 with FERC.

YCWA enters the Yuba River Hydroelectric Project Relicensing with the expressed goal of obtaining a new license with minimal adverse impact to Project economics, while helping to foster YCWA's relationship with the community, resource agencies, and other interested parties. YCWA desires to obtain a new license of maximum term for the Project at a minimum cost (both initially and ongoing) that allows the Project to maximize profits from the production of electrical power while also meeting environmental, recreational, irrigation, and other non-power requirements and needs.

Englebright Dam and Reservoir

Englebright Dam is owned and operated by USACE; however, two electric power generating plants are provided with water through Narrows I and Narrows II outlets to plants operated by PG&E and YCWA respectively. The current FERC license for the Pacific Gas & Electric Company Narrows 1 Powerhouse expires in 2023. The YCWA Narrows 2 Powerhouse is included in the YCWA Yuba River Development Project FERC license.

Camp Far West Dam and Reservoir

Camp Far West Dam is owned and operated by the South Sutter Irrigation District. According to FERC, the relicensing process is scheduled to begin in June of 2019 (FERC, 2014).

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3 Flood Management Challenges and Constraints

The regional flood management system as we know it today consists of many inter-related elements that work together to reduce the risk of flooding. While portions of the regional system; such as the levees, have been constructed and improved over a period of more than 150 years, other elements; such as reservoirs, flood insurance and environmental regulations, have been more recent. Improvements in any portion of the system may improve its overall function, but a comprehensive evaluation is needed to identify the most cost effective and reasonable combination of actions. While the regional flood management system was initially constructed with local resources, without any centralized control, the system is now highly regulated, funded from multiple sources, and involving the participation of a multitude of agencies.

This chapter focuses on the various components of the regional flood management system, first identifying the general issues and concerns associated with each component, then describing specific problem areas in the region. The regional flood management system includes the flood control structures in the region, including levees, channels, drainage facilities, and reservoirs. It also includes the multitude of State and federal agencies, programs, policies, and procedures which profoundly affect how future regional flood management elements are designed, financed, and constructed, how the system is operated and maintained, and how the economic stability and environmental quality of the region are improved over time.

Management of this complex system in a rapidly changing physical, financial, and regulatory environment involves numerous difficult issues and concerns. To help identify and address these concerns, the Central Valley Flood Control Association created a committee called the Sacramento Valley Flood Control Action Work Group in 2008 to help formulate solutions for the 2012 CVFPP process. After adoption of the CVFPP in June 2012, the Association established the Rural LMA Work Group to continue this work by providing input to the RFMP process, including the Feather River Region. In December, 2013 the Association released topic papers covering 11 topics of concern which should be addressed. The key topics of concern are summarized below and are discussed throughout this report. The Work Group report is included in this plan as Appendix E.

Agricultural Floodplain Mapping and Rate Issues – A significant portion of agricultural lands in the Central Valley are mapped as Federal Emergency Management Agency’s (FEMA) regulated floodplains, or Special Flood Hazard Areas (SFHA). The restrictions for a SFHA do not provide the flexibility needed to sustain agriculture including the ability for reinvestment in infrastructure without unreasonable or cost-prohibitive measures. The RFMP effort should motivate changes in Federal law or policy to remove the financial disincentives and barriers to agriculture thriving in leveed basins mapped as FEMA 100-year floodplains.

Channel, Bank, and Bypass Maintenance – Insufficient maintenance of channels and banks of the Sacramento flood control system is adversely impacting its carrying capacity and performance and is compromising the ability of LMAs to maintain PL84-99 eligibility for their levee systems. Barriers to performing adequate maintenance include environmental and regulatory restrictions, insufficient funding and resources, and competing maintenance priorities,

and completing interests of federal and state regulatory and resource agencies, and flood system maintenance agencies.

Flood Structure Protection Area – Create a mechanism to provide LMAs the ability to review land-use activities in the vicinity of flood protection structures so that the activities do not conflict with the design, construction, maintenance, operation of the LMA’s facilities, and do not compromise structure integrity.

Rodent and Burrowing Animal Control – The presence of rodents on levees is a historic and ongoing problem that poses a threat to levee integrity due to increased seepage penetration into the levee and interior and exterior erosion causing voids and levee stability issues via the burrows the rodents create. This problem is exacerbated where nut orchards and other sources of food are readily available near levees.

Continuance in the Federal Program – Continued participation in the Federal Program provides benefits for planning and implementation of major repair and/or improvement projects as well as benefits during and following emergency events. However, deauthorization, or removal from the Federal program through other means, may provide its own benefits. A weighing of advantages and disadvantages should take place to determine if deauthorization should be pursued and if so how and where (i.e., large or small systems, rural or urban systems, etc).

Eligibility in the PL84-99 RIP – Inactive status in the Rehabilitation and Inspection Program (RIP) results in a loss of eligibility for Federal PL 84-99 rehabilitation assistance (i.e., funding) following an emergency event and Sponsors and LMAs would therefore be faced with rehabilitating damaged levees using all non-Federal funds. It is difficult for Rural LMAs to design, implement, and fund rehabilitation of levees following an emergency event without Federal assistance. If LMAs are unable to fund or otherwise implement repairs, it is unclear who would make the repairs and if this responsibility would fall on the State as the non-Federal sponsor.

Pipe Maintenance and Inspection – LMAs lack the enforcement authorities for inspection and maintenance of private and certain public pipe penetrations in their levees. The Central Valley Flood Protection Board (CVFPB), as the authorizing agency, has issued the encroachment permits for these facilities and holds the enforcement authority through the encroachment permits. In light of reluctance for pipe owners to properly inspect and maintain their pipes, there is a need to develop clear enforcement action. Unfortunately, current pipe inspection technology is not sophisticated enough to detect potential failure points at an affordable cost, so there is a need for development of effective methodologies for performing the inspections that do not solely rely on video and sonar.

Encroachments – Undocumented encroachments and non-compliant encroachments present safety and legal challenges for LMAs.

Permitting and Maintenance Activities – Most maintenance activities are exempt from NEPA and CEQA but require compliance with other laws such as State and Federal endangered species laws and California’s streambed alteration law. Compliance with such laws is usually achieved through a permitting process that is burdensome, lengthy, and expensive. As such, some LMAs typically avoid the permitting process altogether to meet obligations for levee safety, or choose to not conduct proper maintenance to avoid consequences from the resource agencies.

Flood Emergency Response – The full benefits of the current LMA structure for levee emergency response and management cannot be realized without cooperatively addressing the staff and financial limitations of LMAs and related jurisdictional issues that prevent more effective, decentralized response to levee problems in a major valley-wide event placing additional response burdens on State and Federal agencies for the flood fight.

Maintenance of Mitigation and Habitat Enhancement Projects – The increasing number of mitigation planting and habitat enhancement projects within the channels, bypasses, and other floodways of the Sacramento and San Joaquin River flood systems together with existing ‘legacy’ mitigation projects is compounding the already challenging regulatory environment faced by levee maintainers. Failure to properly plan, maintain and manage mitigation and habitat enhancement projects is resulting in adverse impacts to hydraulic capacity, conveyance, and ability to inspect, monitor, and flood fight. Further, plantings are migrating beyond their original project limits and the lack of “safe harbor” agreements is creating financial and operational constraints for the LMAs.

3.1 The Regional Levee System

Simply put, a levee is intended to confine channel flows from spreading out over former floodplains, causing variety of effects on people and the environment. To accomplish this simple function, a levee must remain structurally intact throughout the duration of high water. However, during high water events, a levee may be subjected to enormous lateral hydraulic pressures, to uplift pressures from water seeping into the foundation layers below, to the erosive power of flowing water, the effects of saturation that can greatly weaken the structure, to the failure of penetrations such as drainage pipes, and the effects of earthquakes. Subjected to these factors, a levee may fail by sliding on its foundation, sloughing and settling due to saturation and through-levee seepage, being undermined by underseepage, or being washed away by erosion. A small weakness in any given location can be catastrophic; once water is flowing through or over a levee, the material can be quickly washed away, resulting in catastrophic failure such as occurred in two locations on the Feather River levees in 1955, the Yuba River south levee in 1986, and the Feather River east levee in 1997.

To withstand all of these challenges, a levee must be constructed of cohesive soils that can be well compacted, but do not swell when wet and crack when dry. They must have sound foundations that will limit seepage during high flows. They must have adequate cross section and side slopes so they will be stable when saturated and under pressure from high water. They must be protected from erosion. They must be free of rodent holes, be accessible for patrols, and be sufficiently clear of vegetation to facilitate visual inspection and flood fighting. The land side of the levee slope and toe must also be accessible for inspection and emergency repair to assure that the system will perform with adequate resiliency and reliability.

Unfortunately, the regional levee system was built over many years using the sands, silts, clays, and soils, including organic soils, which were conveniently available and often poorly compacted over permeable foundations. In early levee construction the foundation characteristics were simply ignored, except for the evolving practice of constructing a shallow inspection trench. Portions of the levee system suffer from structural instability, erosion, settlement, inadequately designed or decaying penetrations, excessive vegetation, rodent damage, and encroachments.

Each major damaging flood event has prompted a re-examination of the levee system and subsequent improvements in engineering, solution technologies, and facilities. For example, the

1986 flood event prompted a cooperative USACE DWR-led re-evaluation of the Sacramento River Flood Control Project (SRFCP), with subsequent investments in a five-phase re-evaluation and re-construction program, including improvements in Phase II to Marysville and Yuba City area and to the Mid-Valley Project. The 1986 flood also prompted a federal reconnaissance study and subsequent authorization of the Yuba River Basin Project in 1999. This authorized project resulted in re-evaluation and significant advance work by DWR, TRLIA, and Yuba County interests in RD 784. The last construction element is currently underway by USACE to provide greater than 200-year protection to the Marysville Ring Levee.

The 1997 flood prompted a re-evaluation of the importance of levee foundation underseepage. This resulted in more stringent criteria for underseepage being adopted by the USACE in 2003 leading to the implementation of deep cutoff walls, seepage berms, and relief wells.

The levee system offers a multitude of opportunities for improvement, with direct and quantifiable reductions in flood risk. They include fixing known localized deficiencies, regional levee improvement programs such as implemented by TRLIA and SBFCA, changes in management practices, and implementation of new technologies.

3.2 Channels

The historical practice of constructing levees close to the river channels to induce sediment scour and to take advantage of the natural levees deposited by the rivers, has, in many cases, interfered with the natural stream meandering process. Where meandering channels begin to erode levee slopes, erosion protection is required to protect the integrity of the system. Erosion protection can be achieved by placing riprap, biotechnical erosion protection, such as brush boxes, or planting erosion resistant vegetation, such as willows, on the waterside of the levees. Stream banks require costly, ongoing maintenance and repairs. The Sacramento River Bank Protection Project has provided the authority and mechanism for placing the majority of rock revetment along SPFC facilities, including the main channels of the Feather, Yuba, and Bear rivers.

Vegetation growing within the banks of the river channels increase channel roughness and reduce its flood carrying capacity. Whereas vegetation removal by burning, snagging, cutting, and bulldozing was freely practiced in the past, these practices are now severely curtailed, primarily because of the recognition of the importance of the habitat values offered by this vegetation (see Section 4.4 below). While local agencies recognize the benefits of vegetation to minimize erosion and scouring and provide additional stability, they are deeply concerned about the cumulative effects of vegetation growth on flood capacity and the increasing difficulty of performing channel maintenance.

Improved collaboration among maintaining and regulatory agencies, combined with flood corridor planning, offers the opportunity to optimize the channel benefits of flood conveyance and habitat while reducing long-term maintenance costs.

3.3 Reservoirs

Multipurpose reservoirs in the region such as Lake Oroville and New Bullards Bar Reservoir are operated throughout each year to best meet the needs of flood protection, water supply reliability, power production, fisheries, and recreation. While they have greatly reduced the threat of flooding in the region, recent history has demonstrated that with the current flood storage, release

capacities and operational criteria, storms that are larger than the 1997 flood would likely result in flows that exceed channel capacities.

From a regional planning perspective, the greatest short-term opportunities involve refining operations to achieve greater concurrent benefits. Forecast-Coordinated Operations involves careful coordination of releases from different reservoirs to reduce downstream flood peaks, thus improving the overall system reliability. Forecast-Based Operations involves relying more heavily on hydrologic forecasts as the art and science of forecasting becomes more reliable, which could lead to greater reservoir releases prior to a big storm than allowed under current operational criteria and encroaching on flood storage space to save water if forecasts anticipate minimal runoff for the forecast period.

There may also be opportunities to cost-share with State and federal agencies to upgrade facilities, including gates, spillways, dam raises, and power plants to improve reliability, efficiency, capacity and performance.

3.4 Fisheries and Wildlife Habitat

From the latter half of the twentieth century to present has been marked by a growing awareness of the effects of the levee system and the multipurpose reservoirs on the environmental health of the Central Valley's rivers and streams and their associated seasonal wetland and riparian habitats. The geographic extent, quality, and connectivity of native habitats along Central Valley rivers have all declined. 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. The flood management system, including dams, control structures, and levees, hydraulic mining, introduction of invasive species, and other factors have greatly altered natural hydraulic and geomorphic processes. Levees have isolated frequently inundated floodplains from the river channel, hydraulic mining and introduced species have degraded channel and floodplain habitats, and various infrastructure projects have created barriers to fish passage. All these developments have contributed to a reduction in the quality and extent of fisheries and wildlife habitats.

The reduction of these habitats to accommodate the levee system and the reservoirs has impacted the populations of salmon, steelhead, sturgeon, Swainson's hawks, bank swallows, giant garter snakes, valley elderberry longhorn beetle, Western yellow-billed cuckoo, and many other wildlife species in the Central Valley. As a result, preservation and enhancement of the valley's remaining wetland and riparian habitat has become an increasingly important consideration in the planning, design, construction, operations, and maintenance of the flood management system.

Regional Habitat Conservation Plans and River Corridor Management Plans (CMP) offer potentially effective solutions to the current piecemeal approach to mitigating effects on fisheries and wildlife habitats. Additionally, preserving and protecting existing agriculture, encouraging cost-effective strategies to improve habitat values of agriculture and by incorporating habitat improvements in flood control projects will improve the overall ecosystem.

3.5 Operations and Maintenance Constraints

Faced with limited funding, increasing regulatory constraints, and changing expectations for the multiple uses of the flood management system, it is increasingly difficult for local agencies in the Central Valley to maintain levees and channels, which is impacting their ability to maintain the

flood conveyance capacity and integrity of these structures. It is very important to the LMAs and the beneficiaries of the flood protection they provide that LMAs be provided the tools and flexibility needed to perform timely, cost-effective maintenance work as needed year round.

An important consequence of the difficulty of conducting routine maintenance is that it jeopardized eligibility for federal levee rehabilitation funds under Public Law 84-99 (PL 84-99), administered by USACE, and levee accreditation under FEMA's National Flood Insurance Program. Even the levees maintained by DWR in the region have been put on inactive status. – Inactive status in the Rehabilitation and Inspection Program (RIP) results in a loss of eligibility for Federal PL 84-99 rehabilitation assistance (i.e., funding) following an emergency event and Sponsors and LMAs would therefore be faced with rehabilitating damaged levees using all non-Federal funds. It is difficult for Rural LMAs to design, implement, and fund rehabilitation of levees following an emergency event without Federal assistance. If LMAs are unable to fund or otherwise implement repairs, it is unclear who would make the repairs and if this responsibility would fall on the State as the non-Federal sponsor (CVFCA, 2013).

Beginning in 2006, a change in USACE's approach towards woody levee vegetation also poses new challenges for those who operate and maintain the existing system of levees. Since the levee system failures along the Gulf Coast caused by Hurricane Katrina in 2005, USACE has taken the position that no woody vegetation should be tolerated on or near federal project levees and, through a series of administrative actions, has moved to promulgate and enforce this approach. USACE allows for variances from this national policy. It requires that applicants develop detailed analyses which demonstrate that woody vegetation does not impair levee integrity and performance. The variance process is resource-intensive and involves extensive USACE review, up to, and including, approval by the Assistant Secretary of the Army for Civil Works (ASA-CW). Woody vegetation is of great ecological and aesthetic value and due to permitting constraints, is now very costly for local agencies to manage.

On the other hand, insufficient maintenance and the increasing number of mitigation planting and habitat enhancement projects within the channels, bypasses, and other floodways of the Sacramento and San Joaquin River flood systems together with existing 'legacy' mitigation projects are compounding the already challenging regulatory environment faced by levee maintainers. Failure to properly plan, maintain and manage mitigation and habitat enhancement projects is resulting in adverse impacts to hydraulic capacity, conveyance, and ability to inspect, monitor, and flood fight. Further, plantings are migrating beyond their original project limits and the lack of "safe harbor" agreements is creating financial and operational constraints for the LMAs (CVFCA, 2013).

Operations, maintenance and repairs of the flood management system are difficult to execute and often deferred for many reasons. Among the most significant constraints are the cost and difficulty of navigating the regulatory process and the constricted time windows in the year when maintenance work can be carried out. While most maintenance activities are exempt from NEPA and CEQA, they require compliance with other laws such as State and Federal endangered species laws and California's streambed alteration law. Compliance with such laws is usually achieved through a permitting process that is burdensome, lengthy, and expensive. As such, some LMAs typically avoid the permitting process altogether to meet obligations for levee safety, or choose to not conduct proper maintenance to avoid consequences from the resource agencies (CVFCA, 2013).

Burrowing animals such as gophers, muskrats, and beaver can cause dangerous, unseen deficiencies in levee cross-sections. Injection grouting has been a relatively quick and effective tool for filling animal burrows. Concerns about interning GGS is now limiting the use of this approach in many areas. The alternative is excavation and re-compaction of the levee section, a much more extensive and expensive repair process.

LMAs and DWR Sutter yard face essentially the same challenges as local area levee and channel maintaining agencies. Ultimately they are funded through assessments, fees and taxes, which place increasing burdens on property owners, farmers, and taxpayers. DWR's channel maintenance costs are covered by State General Fund dollars (for Water Code §8361(f) responsibilities), and its levee and drainage facilities costs are paid through State General Fund dollars for those facilities described in Water Code §8361 that are maintained by Sutter Yard and through assessments on benefiting properties for MAs established under Water Code §12878-12878.41. LMAs are generally funded through assessments on property, which can only be increased through the Proposition 218 process. In general, the LMAs in the area, including DWR Sutter Yard, are not adequately funded to address major maintenance repairs. Special funding sources and programs are needed to address these needs.

Among the many challenges faced by LMAs and DWR in its role as maintaining agency include:

- Encroachments by underlying or adjacent property owners which threaten levee integrity, inspections, or flood fighting. They are difficult, expensive, and time consuming to deal with, presenting legal and safety challenges for LMAs. Historically the LMAs have received inconsistent and limited support for encroachment removal from the CVFPB and the Office of the State Attorney General.
- Deteriorating levee penetrations for water supply and drainage as well as other purposes can create dangerous, but difficult to detect weaknesses. As noted by the CVFCA (2013), LMAs lack the enforcement authorities for inspection and maintenance of private and certain public pipe penetrations in their levees. The CVFPB, as the authorizing agency, has issued the encroachment permits for these facilities and holds the enforcement authority through the encroachment permits. In light of reluctance of pipe owners to properly inspect and maintain their pipes, there is a need to develop clear enforcement action and cost effective methodology to systematically resolve these concerns.
- Levee slope instability, erosion, caving, cracking, seepage, rutting, rodent burrowing, loss of vegetative cover, loss of revetment.
- Boundary and property management costs, including surveys, boundary markers, title research and legal costs, all of which can be very costly and time consuming, given the complexity of underlying property rights associated with regional flood management facilities. LMAs have found that the easement system is very cumbersome and difficult to administer over time; fee simple ownership of land underlying their facilities greatly reduces the opportunity for misunderstanding and conflict.
- Many LMAs do not have the authority or opportunity to review proposed land use changes in the vicinity of flood control works they maintain. Activities such as excavating soil, placing pipes and poles, or constructing buildings can interfere with the proper functioning of the flood control system or inspection and flood fighting. LMAs

need to be in the permitting process for any significant land use changes which can impact the level of flood protection (CVFCA, 2013). This may require legislative changes.

- Rising insurance and personnel costs.
- Vandalism, dumping, and trespass (especially driving motorcycles and four-wheelers on levee slopes), and petty criminal acts are major concerns. Recently the theft of copper wire and other metals have become rampant in some areas, affecting pump stations, lighting, control panels, and other structures. In some cases, heavy K-rails and concertina wire have been needed to block trespass on critical infrastructure such as pump stations. Patrols and enforcement costs add to the cost of protecting critical infrastructure.
- In general, the LMAs in the area, including DWR Sutter Yard, are not adequately funded to address major maintenance repairs. Special funding sources and programs are needed to address these needs.

Local maintaining agencies have been working with State and federal agencies, as well as non-governmental groups to explore opportunities for addressing these problems.

- Existing laws set relatively short time limits for some environmental permits given that flood management systems need to be managed in perpetuity. With better science, cooperation, and management experience there may be opportunities to modify these laws so that the desired protection is achieved more efficiently.
- Increased partnering and leveraging of multiple funding sources will expand the opportunities for implementing multi-benefit projects.
- Refining work windows that meet the needs for species protection and flood activities, both of which can be very constrained by seasonal events and conditions, will support integrated management of the flood system.
- Improving habitat in ways that reduce, or at least do not substantially increase, needs for maintenance of flood facilities will be important.

3.6 Water Quality

There are several important connections between flood management and water quality. Most importantly, floods are capable of mobilizing enormous sediment loads and any included contaminants, carrying them downstream, and then sorting and re-depositing them. The rivers and streams of the region were heavily impacted by gold mining in the Feather, Yuba, and Bear river basins. As a result, large amounts of mercury were released into the stream system, mainly due to its use in capturing gold from sluice boxes during the Gold Rush. Mercury poses major obstacles to sediment management and ecosystem restoration where it occurs in concentrations above the allowed levels. The potential for mobilization of mercury is a consideration for any channel modification or levee construction project in the region.

When levees fail, the inundation of homes, farms, businesses, and industries often results in the release and dispersion of highly toxic chemicals, which can have far reaching health and economic effects. All of these water quality concerns will continue to affect flood management programs by requiring that contaminants and toxics be addressed in the planning, design,

construction, and maintenance phases of flood management projects, most likely intensifying in the future.

3.7 Increasing Flood Risks

Broadly stated, the levees that were originally constructed to protect largely agricultural areas are inadequate to protect developing areas. Although the regional flood management system has prevented millions of dollars in flood damages since its construction, a better understanding of the risk assessment and engineering standards has made it clear that some of the regional levee segments face an unacceptably high chance of failure. This, combined with growth in the region has increased the estimated level of flood risk. While the chance and frequency of flooding has decreased since construction of the region's levees and multipurpose reservoirs, the damages that would occur if a levee were to fail in one of these areas are much greater, resulting in a net long-term increase in cumulative damages if no further action is taken to improve the flood management system or to limit further development in these areas.

3.8 Re-evaluation of Levee Performance

The methods used by USACE and DWR to estimate flood risk have become more conservative. Since 1995, USACE has been developing and implementing its risk and uncertainty methods, as well as upgrading its structural design criteria, with the net result that many existing facilities, which were previously rated as substantially adequate to meet project design criteria, have subsequently been downgraded. For example, the Natomas levee system, thought to provide 200-year to 400-year protection when upgraded in 1998, was downgraded to a 30-year rating ten years later.

3.9 Evolving Levee Standards

Standards for the design, construction, and management of levees have evolved over time, often in response to structural failures during floods. SPFC levees have been constructed through the individual and combined efforts of local, State, and federal agencies. The facilities were constructed with materials at hand over many decades, to meet evolving design standards and using construction techniques. As a result, these facilities provide varying levels of protection, depending on when and how they were constructed and upgraded (DWR, 2012).

3.9.1 USACE Levee Standards

In 2005, Hurricane Katrina caused widespread flooding and devastation along the Gulf Coast, most notably the flooding of much of New Orleans. As a result, USACE launched a multi-pronged effort to improve levee management nationwide, including the creation of a national levee database, risk notification procedures, and more stringent enforcement of its levee standards. Among the key changes in the USACE approach to national levee standards was the promulgation of levee vegetation management standards, which have had the effect of requiring the removal of most woody vegetation from levee slopes and adjacent ground. From the State perspective, the removal of woody vegetation does not rank high in terms of levee safety risks. Accordingly, the CVFPP recommends a life cycle approach to vegetation management, in which woody vegetation is monitored and managed to assure that it does not pose localized threats to levee integrity. USACE has also stepped up enforcement of other standards for various aspects of levee integrity, including encroachments, penetrations, erosion protection, patrol roads, and structural cross sections.

Levees that are deemed noncompliant with current USACE standards risk being classified as inactive in the federal Rehabilitation and Inspection Program (RIP), which would make the levees ineligible for PL 84-99 rehabilitation assistance in the event of damage or failure during a flood. In addition, in many cases FEMA has based its National Flood Insurance Rate Maps (FIRM) hazard classification upon USACE determinations or certifications of levee integrity and channel capacity. When USACE downgrades levee structural ratings within its evolving standards, re-mapping by FEMA is a likely outcome.

Since 1995 USACE has been implementing a Risk and Uncertainty (R and U) approach to rating levee performance. This process is also evolving as these procedures are intended to explicitly include statistical risk and uncertainty estimates for all of the factors which significantly affect levee performance, which can be a very complex undertaking, particularly for a system of levees and channels which provide flood protection for the Feather River region. The net effect of implementing the R and U approach has been to raise the required levee performance standards for federally authorized levees, such as the Project levees in the region.

3.9.2 State Levee Standards

Prior to 2008, the State primarily relied on USACE levee design, construction, operation, and management standards. Its historic role in the region included cost sharing in the construction of Project levees, providing Lands, Easements, Real Estate, Relocations (LERRDs), borrow materials, and Disposal sites, and certifying that the State, through the CVFPB, would take responsibility for Operation, Maintenance, Repair, and Rehabilitation (OMRR).

With the enactment of SB 5 (Machado, 2007); however, the State's role in establishing levee standards was expanded. SB 5 requires that, in order to continue to develop, urban and urbanizing areas must meet, or have a credible plan to meet, a 200-year level of flood protection within three years of the adoption of the Central Valley Flood Protection Plan, which occurred on June 29, 2012. Similarly, small communities must comply with FEMA's 100-year level of flood protection standards.

This new requirement has prompted DWR to work with interested stakeholders to develop and issue two closely related documents.

The *Draft Urban Level of Flood Protection Criteria* (ULOP, October 2013) describes criteria and a systematic approach for cities and counties to apply them to determine whether or not they need to make a finding regarding whether a specific area must meet urban level of flood protection criteria or FEMA 100-year criteria in order to continue to develop.

This document incorporates by reference *Urban Levee Design Criteria* (ULDC, May 2012), which describes the levee and floodwall design criteria developed by DWR for providing the urban level of flood protection (Government Code Section 65007(k) and California Water Code Section 9602(i)).

These documents were developed with input from a diverse work group of representatives from cities, counties, other State and federal agencies, and associated professional organizations. Since release of the draft criteria, Senate Bill 1278 and Assembly Bill 1965 of 2012 were passed to amend the original 2007 Senate Bill 5 to clarify certain aspects of the 2007 legislation, and to amend some of the milestone dates and timeframes. It is anticipated that the procedures and criteria described in these documents will continue to evolve in response to public comments, new legislation, and unforeseen implementation challenges.

3.9.3 Rural Levee Repair Criteria

Most of the levees in the region were constructed to a geometry standard with the intent to pass design flows with adequate freeboard, and although they were improved and incorporated into the Sacramento River Flood Control Project, they do not meet current levee engineering performance standards because of inadequate cross sections, geotechnical weaknesses, erosion, encroachments, penetrations, or other concerns. It is unlikely that the combined resources of regional LMAs and the communities they protect can fund improvements to achieve a FEMA 100-year level of flood protection or better, even if State and federal funds are leveraged to the extent feasible. Nevertheless, it is important to improve flood protection for rural-agricultural areas, in accordance with the priorities set by the communities in the region.

In preparing and adopting the CVFPP, both DWR and CVFPB made strong commitments to work with LMAs in the Central Valley to develop local and regional flood management plans for repairs and improvements to rural-agricultural levee systems, including the development of rural-agricultural levee repair criteria.

The purpose of developing a set of common, consistent rural-agricultural levee repair criteria is to achieve the most cost effective reductions in flood risk feasible for these areas. This will likely require a strategy of making numerous repairs and improvements to multiple sites with known deficiencies. Available funds can be stretched further if repair criteria are less stringent than those required for urban areas or small communities.

Consistent with the State commitments, the Rural Levee Repair Criteria (RLRC) are currently under development by DWR, in coordination with the CVFPB, for levee repairs in the Central Valley's rural-agricultural areas. DWR has formed a work group of interested stakeholders to help develop criteria to be used to guide repair of documented rural levee performance problems. In addition to DWR staff, work group members will include representatives of the local maintaining agencies, CVFPB Board member(s) and staff, USACE representatives, and other interested parties (DWR, June 2013). Draft criteria are expected to be released by December 2013.

3.10 Floodplain Re-mapping and Levee De-certification

When FEMA's National Flood Insurance Program was first established in 1968, areas protected by USACE levees were presumed to meet 100-year criteria. As a result, most of the floodplains in the region protected by the levees of the State Plan of Flood Control were mapped with 100-year ratings. High flows and levee failures during February 1986 led to recognition that the levee system may provide less than 100-year protection, particularly in the Sacramento area, where portions of the levee system were de-certified and the floodplain was re-mapped as a high hazard area.

The January 1997 flood further exposed the weaknesses of the levee system, particularly with regard to underseepage.

Both FEMA and DWR recognized the importance of updating the NFIP maps to accurately reflect the flood hazard and worked cooperatively to expedite the mapping process in California. In 2000 DWR embarked on a floodplain remapping study in the region, divided into the lower Feather River and Upper Feather River regions. The Lower Feather River Floodplain Mapping Study was completed in 2003 and led to the designation of much of the Feather River region with less than 100-year flood protection (see Figure 3-1).

The Upper Feather River study is still underway and is expected to delineate most of the upper portions of the region with less than 100-year protection.

On August 22, 2005, FEMA issued Procedure Memorandum 34 (PM 34), which fundamentally reversed the historic presumption regarding the federally authorized levee system by requiring that the agencies responsible for levees demonstrate and document the integrity of their levee systems.

Recognizing that in many cases responsible agencies would need to conduct extensive field work, hydraulic and hydrologic studies, and geotechnical and engineering analyses in order to demonstrate that their levees met FEMA's certification criteria, FEMA issued PM 43 on March 16, 2007. PM 43 permits FEMA or its mapping partners to issue preliminary and effective FIRMS with Provisionally Accredited Levees (PALs) if the responsible agencies believe that their systems meet 100-year criteria, but cannot provide adequate supporting documentation. The PAL designation provides the responsible agencies 24 months to gather and provide the necessary documentation.

The City of Marysville obtained a PAL rating for its levee system, but the PAL expired in 2010. RD 784 obtained a PAL rating for a portion of its levee system, and anticipates certifying the PAL reach upon completion of work in the Yuba Goldfields.

In the aftermath of the Katrina disaster of 2005 and as a result of PMs 34 and 43, both FEMA and USACE have implemented policies and programs that will likely have the effect of increasing the cost of mandatory flood insurance policies for floodplain homes and businesses and increasing the cost of repairs after a levee failure. For example, FEMA's flood risk map digitizing and risk reassessment efforts will result in remapping of much of the region as providing less than 100-year (1% annual chance) flood protection. As a result, development in these areas will be more expensive, difficult to insure, and subject to flood-proofing or elevation requirements.

A significant portion of agricultural lands in the Central Valley are mapped as Federal Emergency Management Agency's (FEMA) regulated floodplains, or Special Flood Hazard Areas (SFHA). The restrictions for a SFHA do not provide the flexibility needed to sustain agriculture including the ability for reinvestment in infrastructure without unreasonable or cost-prohibitive measures (CVFCA, 2013).

In July 2012, the U. S. Congress passed the Biggert-Waters Flood Insurance Reform Act of 2012 (BW-12), which calls on the FEMA and other agencies to make a number of changes to the way the NFIP is run. Some of these changes already have occurred and others will be implemented over time.

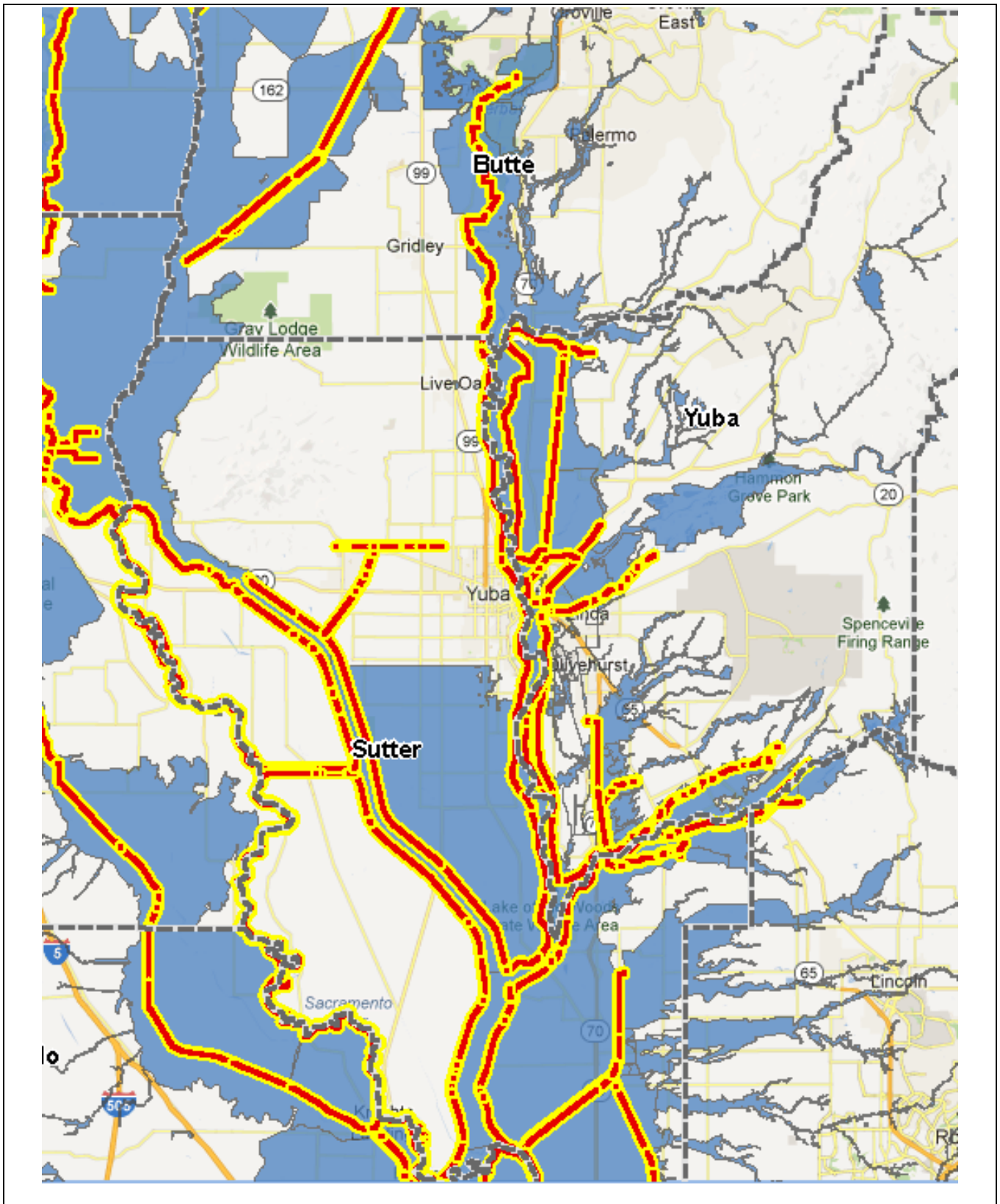


Figure 3-1. Current FEMA floodplain delineations for the region

Key provisions of the legislation will require the NFIP to raise rates to reflect true flood risk, make the program more financially stable, and change how FIRM updates impact policyholders. Over time, the changes will mean the premium rate increases for some, but not all, policyholders.

Levee systems are inspected through the USACE Rehabilitation and Inspection Program (RIP). Systems that receive unacceptable ratings through either routine or periodic continuing-eligibility inspections are placed on inactive status in the RIP, which affects the amount and type of federal funding assistance a non-federal sponsor may receive following a flood event. A system status of inactive in the RIP results in a loss of PL 84-99 rehabilitation assistance following a flood event. It does not necessarily result in a loss of FEMA NFIP certification or accreditation nor does it result in a loss of federal assistance for flood fighting.

Flood control works that are eligible for USACE's RIP, Active or Inactive, are ineligible for assistance from FEMA for emergency and/or permanent repairs. FEMA may provide assistance for the placement and removal of flood fighting measures (e.g., sandbags, buttresses) on flood control works that are eligible for USACE's RIP program if such activity is necessary to eliminate an immediate threat to life, public health and safety, or improved property.

Loss of eligibility for the PL 84-99 RIP would mean that the LMAs and the State of California would have to fully fund rehabilitation following a high-water event.

The passage of Senate Bill 5 has set an even higher threshold for urban areas by requiring that they ultimately be provided with at least 200-year (0.5% annual chance) flood protection no later than 2025 as a condition for further development. This will have the likely effect of limiting further floodplain development and increasing the State and local costs of providing the required levels of flood protection.

In summary, the flood risk evaluation and designation process has been very dynamic since the 1986 flood, with increasingly stringent standards for all aspects of levee system management being developed, as responsible agencies work to upgrade their levees to keep pace with these standards. The re-mapping process has rapidly altered the regulatory environment for floodplain residents and businesses, while the costs of addressing levee structural and maintenance issues have escalated rapidly. As Figure 3-2 illustrates, the responsible agencies are in a race against time, seeking to improve levee integrity to higher 100-year and 200-year standards and avoid the high cost of flood insurance associated with high flood hazard zones.

3.11 Land Ownership and Land Use Conflicts

Land ownership underlying the flood management facilities in the region is a patchwork of private and public parcels. A variety of easements cover many private parcels and these easements have been established for a variety of different and often site-specific purposes. The types and terms of these easements relate to, for example, levee operation and maintenance, periodic flooding, conservation of agricultural land, and habitat restoration. This patchwork of land ownership and easements both constrains and complicates the potential for providing flood or environmental improvements over areas greater than individual parcels.

Impacts of modifications to facilities and environmental restoration on adjacent properties must also be carefully considered and mitigated, where feasible. For example, where wildlife habitat is proposed in proximity to existing agricultural lands, the impacts of plowing, spraying, and harvesting of agricultural lands on nearby wildlife habitat and, conversely, the impacts of

protected species on agricultural lands, must both be carefully addressed to successfully implement flood risk reduction projects with environmental enhancement components.

For example the Yuba-Sutter Farm Bureau noted several examples of wildlife impacts on farm operations in its January 22, 2014 comment letter on the October 4, 2013 draft of this plan. Among them are the following:

- U.S. sheep producers attributed 39,800 sheep and 126,000 lamb deaths (valued at \$9.6 million) to coyotes in 1999; this was 61% of their total losses (NASS).
- Fruit loss to birds is a long-standing and costly problem for many producers of tree crops. A survey of honeycrisp apple, blueberry, cherry, and wine grape growers in California, Michigan, New York, Oregon, and Washington estimates that current bird damage costs per hectare ranges from \$104 to \$7,267 (Anderson, 1).
- Deer can be very destructive to gardens, orchards, and landscaped areas (Salmon, 1).

While the cited statistics cannot be directly scaled to the Feather River region, these examples reflect important concerns and challenges faced by farmers and ranchers which must be carefully considered when planning new environmental enhancements. A major goal of the RFMP will be to develop projects that provide mutual benefits to agriculture and ecosystem functions.

3.12 Funding

Major capital improvement and routine maintenance of the flood management system are primarily dependent on public funding generated by local, State, and federal sources. Flood risk management programs must compete with numerous other pressing funding needs such as education, transportation, health, and welfare. Major infusions of funding for flood risk management have historically followed major floods, when public attention is focused on the catastrophic damages they cause. For example, Propositions 1E and 84, with a combined bond funding capability of \$4.9 billion, were approved by California voters a little more than a year after Hurricane Katrina flooded and destroyed much of New Orleans, killing over 1,200 people. However, flood risk reduction programs and infrastructure need steady, long-term funding to achieve and sustain the requisite level of protection. Governments at all levels struggling with heavy debt burdens, recession-damped revenue projections, and rising construction costs all add uncertainty for fully funding the flood risk management programs and projects described in this report.

Current trends suggest that future federal funding for flood risk reduction projects will be diminishing over time, as the federal government struggles to achieve a balanced budget while facing enormous pressure from nationwide entitlement programs, infrastructure needs, and defense needs.

State bond funds, which are authorized until June 20, 2016, will need to be supplemented by subsequent bond measures or other sources to maintain current levels of State leadership in Central Valley flood risk reduction.

3.13 Future Climate Change

Future climate change may lead to a greater fraction of seasonal precipitation occurring as rain rather than snow. Scientific trends appear to be established and, if they continue as expected, will put increasing stress on the region's flood management system. As California's climate changes,

floodplain risk assessments and development constraints will likely be adjusted accordingly. For example, the 100-year and 200- year (1% and 0.5% annual chance) flood events, calculated based on historical flood events may become larger for the Feather, Yuba and Bear rivers, with long-term effects on National Flood Insurance Program map ratings, flood insurance costs, floodplain development, and the economic viability of the region. In addition, if the moderating effects of snowpack on runoff decrease, there will be a need for more water supply storage, putting greater pressure on existing multipurpose reservoirs protecting the region. It may also provide additional justification for additional multi-purpose storage projects such as the proposed Sites Reservoir in Colusa County. Increased seasonal temperatures and altered runoff patterns would also affect agriculture and the health of the region's remaining ecosystems and habitats. This climate uncertainty requires flexibility in flood management planning.

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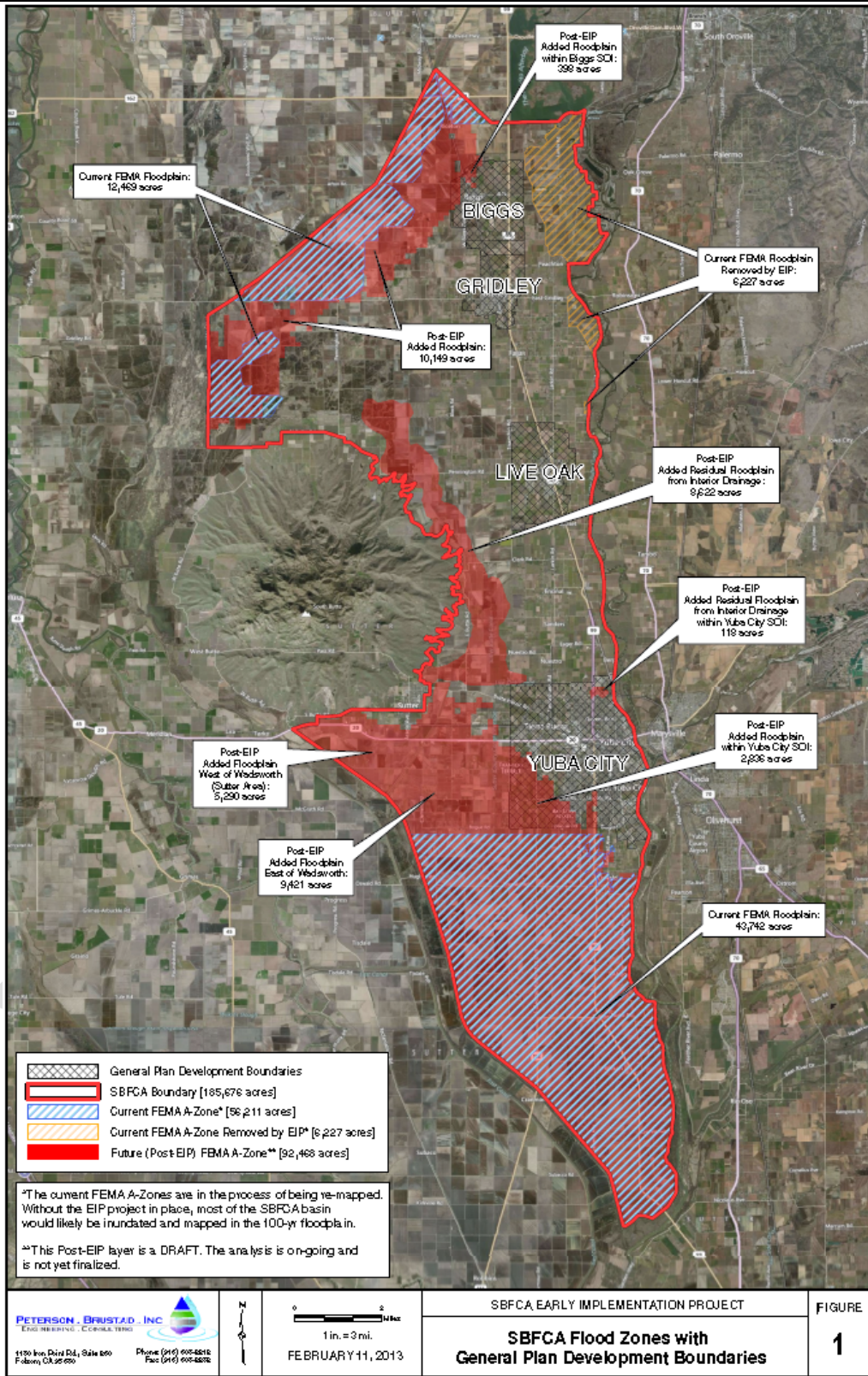


Figure 3-2. Evolving Floodplain mapping for the SBFCA protection zones

4 Assessment of Flood Hazards in the Feather River Region: Flood Frequencies, Deficiencies, Assets and Risks

4.1 Introduction

As described in Section 2.5, the region is characterized by dry summers and wet winters, which under the right conditions, can generate rapidly rising, extreme floods. Where the natural floodplains have been occupied and protected by upstream reservoirs and levees, the magnitude, timing, and duration of flood events must be evaluated in light of existing and proposed flood management facilities. A great deal of effort and data is required to complete full analysis. A new analysis has not been completed as part of this study; it relies on previous reports where available.

The climate and topography of the region together create the potential for extreme winter flood events. Estimates of the flood risk are best characterized by the flood duration-frequency graphs. Nevertheless, it is important to describe the analysis of flood frequency and risk in order to properly use and interpret available data. The key concepts are summarized below.

4.1.1 Flood Frequency and Duration Analysis

Floods can be characterized as large pulses of water that move through a river system. Both the peak flow values of these pulses and their duration are important and must be considered together. To determine the chance of exceeding a particular peak flow and duration, the historic flow records for the point of interest are analyzed to obtain a series of events that are ranked from largest to smallest to assign probability values for each peak flow and duration. For example, the largest instantaneous peak flows for each year of a gage record can be gleaned from the record, ranked and plotted, to obtain an estimate of the 100-year peak flow at a gaging station (Figure 4-1). Such estimates must be updated from time to time as new data becomes available.

For large river systems such as the Feather and Yuba rivers, it is important to look at average peak flows for durations of one day, two days, three days, and so on, to determine which duration creates the greatest stress for downstream flood management systems. For the Feather River and the Yuba River, the peaks with durations of one day to three days tend to be most challenging for the regional flood management system because they are most likely to exhaust the limited reservoir storage capacity in Lake Oroville and New Bullards Bar Reservoir. Table 4-1 illustrates this concept, showing the return periods of storms that would exceed downstream capacity in the absence of upstream reservoir regulation.

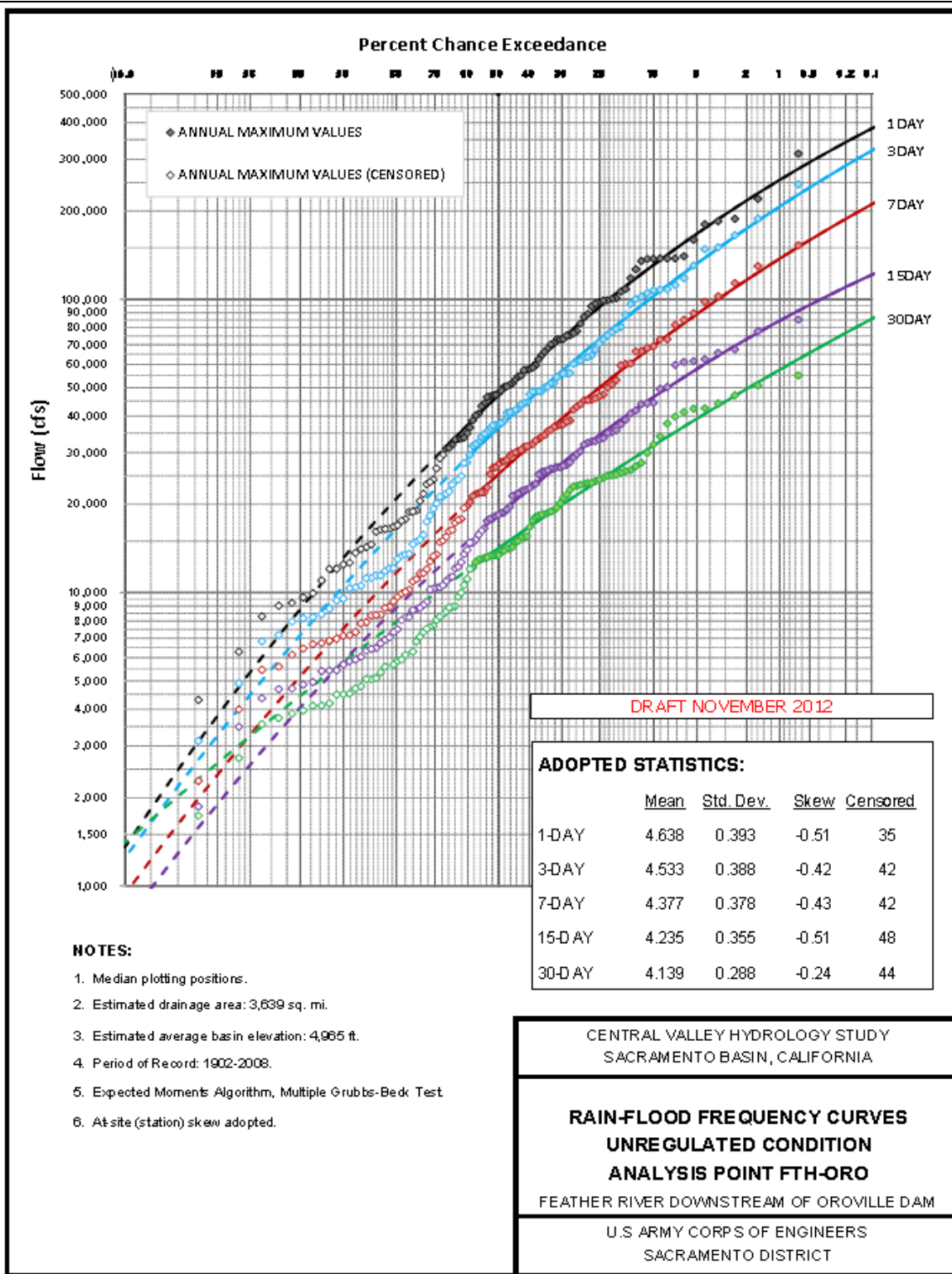


Figure 4-1. Feather River Downstream of Oroville Dam, Unregulated Peak Flows
Source: USACE 2012. Draft Central Valley Hydrology Study

Table 4-1. Feather River Channel Capacity and Return Periods

Reach	Design Channel Capacity	Rain Flood Return Period (years)				
		1-Day	3-Day	7-Day	15-Day	30-Day
Downstream of Oroville Dam	210,000	40	100	667	-	-
Downstream of Honcut Creek	210,000	33	77	500	-	-
Downstream of Jack Slough	300,000	167	400	-	-	-
Downstream of Yuba River	300,000	25	50	333	-	-
Downstream of Bear River	320,000	20	33	200	-	-

Source: California Department of Water Resources Flood Emergency Response Information Exchange (FERIX), CVHS. Web. Queried 24 Jun 2013. (Layer: "Sac SanJQ Ch. Cap.")

4.1.2 Effect of Reservoirs on Flood Frequencies

Estimates of historic flood frequencies generated by upstream watersheds are combined with the simulated operation of downstream reservoirs to develop a regulated flow frequency curve. Such regulated flow frequency curves limit downstream releases to stay within downstream channel capacity until reservoir flood storage capacity is exceeded, then flows rise sharply thereafter (Figure 4-2). As the figure shows, the regulated downstream flows are substantially less than unregulated flows for floods of return periods less than 200 years.

4.1.3 Water Surface Profiles

As flood flows are conveyed downstream, water elevations rise to accommodate the increased flows, and the water either spreads out over adjoining flood plains or rises against confining levees. The relationship between stage and flow at any given location (typically at a gaging location) is called a rating curve, such as shown in Figure 4-3.

The relationship between stage and flow can be extended along the length of a stream channel to provide a water surface profile, and can be computed or measured for storms of various magnitudes. The water surface profile depends on many factors, including the magnitude and duration of the flood wave and channel roughness, shape, and capacity.

4.1.4 Chance of Levee Overtopping or Structural Failure

Given detailed knowledge about the confining levees such as height, cross sectional shape, materials, and foundation conditions, it is possible to make estimates of the chance of levee overtopping or structural failure. Such estimates are very difficult to make reliably because there are many possible causes of failure and weaknesses, such as rodent burrows, rusting pipes, or sand lenses may go undetected even with a very thorough levee inspection.

Estimates of the chances of levee and the amount of direct flood damage are related to both the types and extent of damageable property and the depth of flooding. The indirect effects of such damage on the regional economy can also be estimated.

With this analytical framework in mind it is important to distinguish between the chance of flooding and the risk of flooding. The chance of flooding describes the probability of its occurrence, such as the chance of tossing a coin and getting four heads in a row. The risk associated with flooding also takes into consideration both the chance of flooding as well as the

damage that might occur, in the same way in which automobile insurance rates depend upon both your driving record and the value of your automobile.

4.1.5 Role of Mathematical Modeling

Detailed mathematical modeling is typically undertaken for feasibility-level studies, to subsequent design and construction. Over the past several decades the Sacramento Valley flood management system has been modeled with increasing levels of accuracy and sophistication. A complete system hydrologic analysis was completed as part of the Sacramento-San Joaquin Comprehensive Study (2002). DWR has recently worked closely with USACE to update and refine the hydrologic and hydraulic modeling system for the Sacramento Valley, including the Feather River Region, under two inter-related programs. These studies are currently in progress and results are expected to be available in 2014.

The Central Valley Hydrology Study (CVHS) is providing updated unregulated flow-frequency curves for streams throughout the valley at key locations, simulating the effects of reservoir regulation on those stream flows, and evaluating the effects of climate change on the system in the future.

The Central Valley Floodplain Evaluation and Delineation Program (CVFED) is providing updated mathematical models for evaluating flood risks and alternatives for reducing those risks, improved topographic mapping and floodplain delineation, and improved flood risk information for use by local, State, and federal agencies involved in land use planning and flood risk evaluation.

4.2 Reservoirs: Flood Risk Reduction and Potential Hazards

The major reservoirs in the region are Oroville Dam and Lake, New Bullards Bar Dam and Reservoir, Englebright Dam and Reservoir and Camp Far West Dam and Reservoir. In addition there are numerous upstream reservoirs on the Feather River, Yuba River, and Bear River watersheds, operated primarily for water conservation, recreation, debris control, and power generation purposes.

While the four major reservoirs provide great benefits in terms of flood protection, water conservation, power generation, and lake recreation, there exists a remote, but not insignificant, risk of failure due to extreme flood events or other causes, which is beyond the scope of this study.

The risk of uncontrolled spills that can exceed downstream channel capacities and cause damage to facilities is significant. This risk is a function of both the physical storage and release capacities of the reservoirs, as well as the rules by which they are operated. Each of the major reservoirs and their roles in flood risk management are discussed in the following paragraphs.

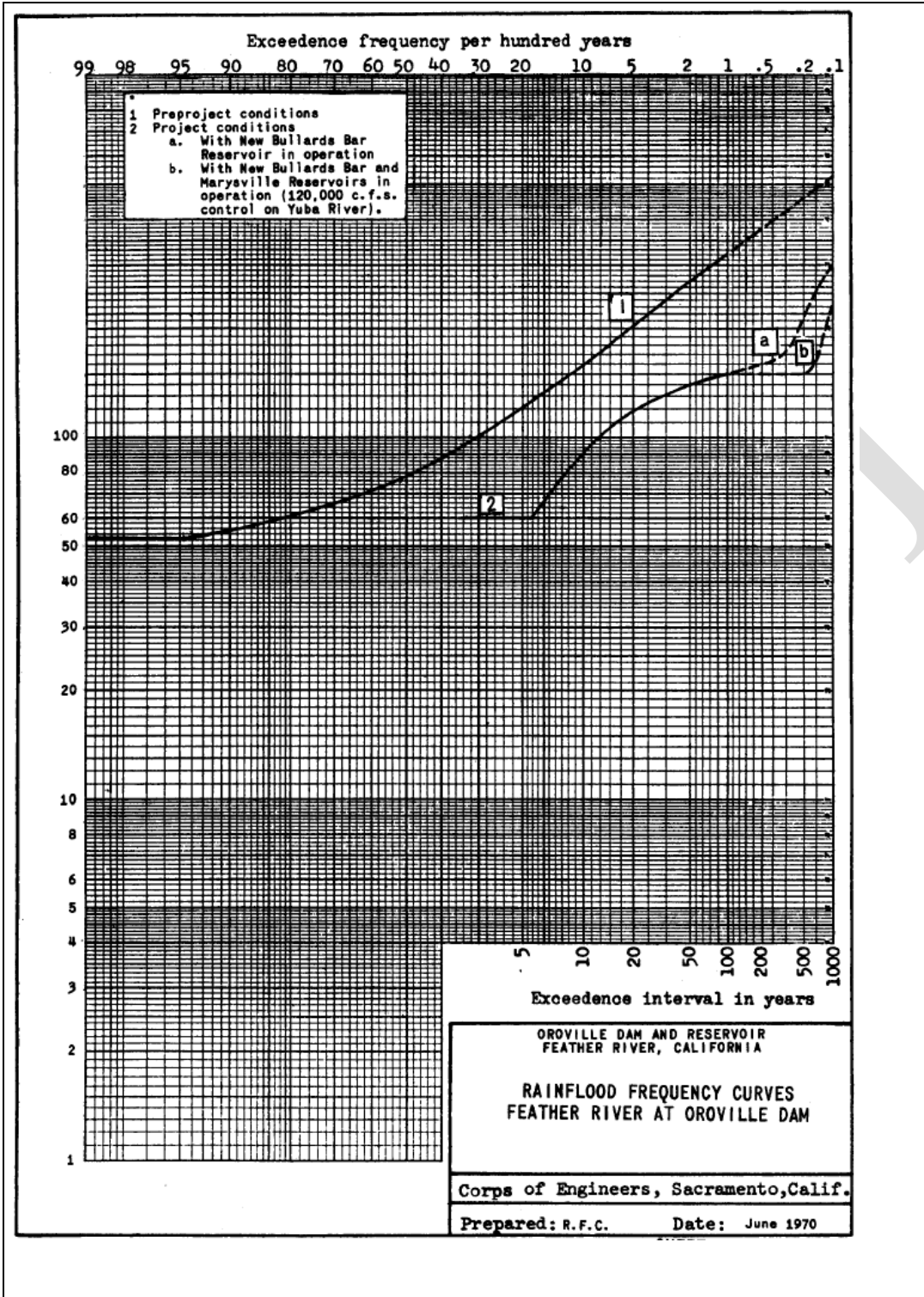


Figure 4-2. Feather River Downstream of Oroville Dam, Regulated Peak Flows

Source: USACE 1970, Oroville Dam and Reservoir, Feather River, California, Report on Reservoir Regulation for Flood Control, August 1970

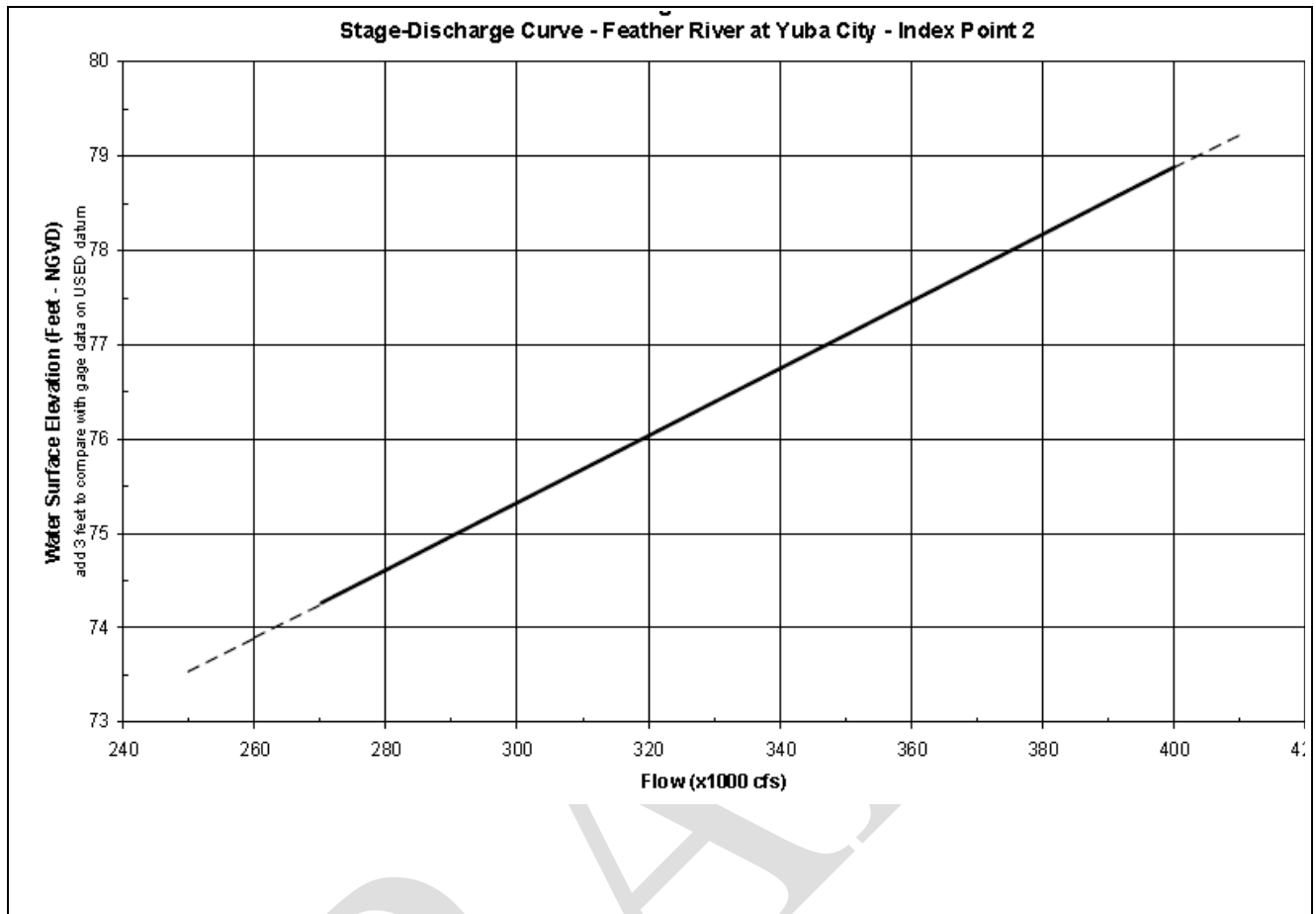


Figure 4-3. Stage - Discharge Curve

Source: YCWA, 2002, Yuba-Feather Supplemental Flood Control Project

4.2.1 Oroville Dam and Lake

The State Water Project (SWP) of DWR operates Oroville Dam and Lake (Oroville). It is the second largest state reservoir in northern California (Shasta lake is the largest), with more than 167 miles of shoreline. It is also the tallest dam in the United States, measuring 770 feet high – 44 feet taller than Hoover Dam – and 6,920 feet across. The lake is located where the North, Middle, and South Forks, and the West Branches of the Feather River join. Lake Oroville is operated for multiple purposes, including flood control.

The reservoir captures drainage from a 3,611 square-mile watershed. It provides a full pool with 3,538,000 acre-feet of storage, up to 750,000 acre-feet of which is governed by flood control regulations. The emergency spillway at Oroville Dam is 1,730 feet long with a crest elevation of 901 feet msl. Thermalito Afterbay (Thermalito) is located downstream from Oroville Dam. It has 45,000 acre-feet of reservoir storage space for re-regulation of Oroville power releases.

The operational flood control rules for Oroville are determined by the USACE (1970) and published in the Oroville Dam and Reservoir Flood Control Manual. The Flood Control Diagram (FCD) and Emergency Spillway Release Diagram (ESRD) contained in that manual together govern the flood control releases from Lake Oroville. The operational flood rules dictate the

amount of flood space that is required to be made available and provide criteria for determination of outflows from Lake Oroville during a flood event.

The amount of flood control space in Lake Oroville is a function of the time of the year and the seasonal accumulation of precipitation for the reservoir's drainage basin. No flood space is required from June 15 to September 15. During the peak flood season (October 15 – March 31), the flood control space varies between 375,000 and 750,000 acre-feet, depending on the accumulated precipitation parameter prescribed in the flood control manual.

There are several release restrictions on Oroville Dam and Reservoir:

- The first constraint is that maximum flood control releases should not exceed 150,000 cfs.
- The second constraint is that flows should not exceed 180,000 cfs just upstream of the mouth of the Yuba River, intended to protect Yuba City and Marysville. This means that if local inflows are forecast to rise above 30,000 cfs, Lake Oroville releases must be less than 150,000 cfs in order to keep the total flow at this location from exceeding 180,000 cfs. Local inflows are rarely large enough to be the determining factor in limiting Lake Oroville releases.
- The next downstream condition that potentially limits the outflow from Lake Oroville is the 300,000 cfs Feather River target flow below the mouth of the Yuba River. Regulating outflows for this requirement at Lake Oroville implies a foreknowledge of the flow in the Yuba River at its mouth, and therefore, Lake Oroville operations must rely on a forecast of the Yuba River flow at Marysville (the New Bullards Bar outflow and the unregulated South and Middle Yuba River flows) to meet this target. The Yuba River flow at its mouth must exceed 120,000 cfs before Oroville operations are affected by this constraint.
- The final downstream peak flow constraint on Lake Oroville outflow is the 320,000 cfs target for flow downstream of the Bear River.

In addition, the rate of increase in releases and decrease in releases must not exceed 10,000 cfs and 5,000 cfs per two-hour period, respectively. The maximum rate-of-decrease criterion is the more influential of these two for large flood events. In some cases, the rapidly peaking flows of the Yuba River require cutbacks in Lake Oroville releases to keep total flows below the combined flow targets downstream of the Yuba and Bear rivers, but the required cutback rates greatly exceed the 5,000 cfs per two-hour target. The only practical solution is to operate for a target flow of less than 300,000 cfs downstream of the Yuba River. This condition would only exist for floods significantly larger than the 1997 flood.

The emergency spillway at Lake Oroville was designed to pass a flood with a peak inflow of 718,000 cfs, yielding an outflow of 623,200 cfs operating with the use of the FCD and ESRD.

The ESRD computes a required release from Lake Oroville based on the elevation and rate-of-rise of the reservoir. The ESRD becomes active when required releases under the ESRD become larger than the release specified by the FCD. It is important to note that this diagram uses the rate of rise criteria as a surrogate for reservoir inflow.

ESRD was created with the assumption that the Marysville Dam would be constructed on the Yuba River. With Marysville Reservoir in place, approximately 120,000 cfs would enter the

Feather River from the Yuba River during major flood events. Since Marysville Reservoir has not been constructed, a large portion of the Yuba River flow is unregulated, and the Yuba River contribution to the Feather can exceed 200,000 cfs during flood events. Consequently, Oroville must reduce outflows to avoid exceeding its flow target downstream of Marysville-Yuba City under such a condition. The Flood Control Manual requires that, until Marysville Dam is constructed, Oroville's outflow gates be operated to hold 150,000 cfs while the reservoir surcharges up to the elevation of the emergency spillway. The reduced outflows from Oroville mean greater rates of rise in Lake Oroville levels. Consequently, the ESRD activates sooner, and could result in emergency releases that are larger than would be required if Marysville Dam was in place. The ESRD controls outflows at Oroville for floods larger than the 1 in 150 annual expectancy probabilities (AEP) - See Appendix B.

The spillway of the Oroville emergency spillway is an unprotected hillside, which would suffer severe erosion in the event that the emergency spillway is used. The hillside damage, as well as the downstream transport of eroded soil and rock, would both be operational concerns, leading to consideration of options for limiting such structural damage under large flood scenarios.

4.2.2 New Bullards Bar Dam and Reservoir

New Bullards Bar Reservoir, owned and operated by YCWA, drains a 489 square-mile watershed, which represents just 40 percent of the 1,339 square mile drainage area of the Yuba River at Marysville. The reservoir provides a full pool of 966,000 acre-feet of storage, up to 170,000 acre-feet of which is required for flood control. Power is generated at the downstream Colgate power plant, which has a maximum outflow of 3,500 cfs.

The operational flood control rules for New Bullards Dam and Reservoir as prescribed by USACE (1972) are contained in the New Bullards Bar Reservoir Flood Control Manual. The FCD and ESRD contained in this manual together govern the flood control releases from New Bullards Bar. Flood releases are subject to downstream flow limitations at the mouth of the Yuba River and release rate-of-change criteria.

The amount of flood control space required in New Bullards Bar is variable, depending on the time of the year. No flood space is required from June 1 to September 15. During the peak flood season (November 1 to March 31), the flood control space is a constant 170,000 acre-feet. The maximum prescribed outflow from New Bullards Bar Reservoir is 50,000 cfs.

The outflows from New Bullards Bar are limited such that flows do not exceed 120,000 cfs in the Yuba River at Marysville when concurrent Feather River flows are "high", and 180,000 cfs when concurrent Feather River flows are "low."

Emergency spillway operations at New Bullards Bar must be made in accordance with the ESRD, which determines releases based on reservoir elevation and rate of rise in reservoir elevation.

The existing New Bullards Bar Dam spillway has limited capacity when water is near the bottom of the flood control reservation. In addition, the New Colgate Powerhouse must shut down from backwater impacts during major flood events, reducing the flood release capacity through the powerhouse by up to 3,500 cfs. Several options are under consideration to address these structural and operational concerns.

The Middle and South Yuba rivers present a special challenge in operations of the system. These rivers are essentially uncontrolled from a flood control perspective and can generate flows of such large magnitude that objective downstream flow capacities (described above) can be exceeded unless timely reductions in outflows from Lake Oroville and New Bullards Bar Reservoir can offset the rapid increase in flows from these drainages. The system is additionally challenged by the fact that the capacity of the Yuba River levees is dependent on the flow in the Feather River downstream from the Yuba River. These conditions make the coordinated operation of Oroville and New Bullards Bar Reservoirs the most difficult in California and the most dependent on good forecasting and management of river flows.

4.2.3 Englebright Dam and Reservoir

Englebright Dam marks the division between the upper and lower Yuba River. It was constructed by USACE in 1941 to capture gold-rush era hydraulic mining debris that threatened downstream areas with floods. Englebright Reservoir has a storage capacity of 70,000 acre-feet, but reservoir operations has limited storage fluctuations to the top 5,000 acre-feet. Englebright Reservoir provides hydraulic mining debris storage along with hydraulic head for electricity generation. It also provides recreational opportunities. Its flood control benefits during major floods are negligible, since there is no dedicated flood control storage, or gates with which to manage flood flows. The USGS has recently characterized the quantity and contamination levels of sediment in Englebright, which includes large amounts of mercury carried downstream from gold mines in the watershed. As a result of this contamination, it is a Clean Water Act 303(d) listed site.

Wild Chinook salmon spawn below Englebright Dam. An important agreement to manage in-stream flows on the Lower Yuba River below Englebright Dam to protect Chinook salmon and steelhead trout was forged in 2008. According to YCWA (YCWA, 2014),

“The Lower Yuba River Accord (Yuba Accord) concludes a 20-year California controversy, and enables the Yuba County Water Agency to successfully operate the Yuba River Development Project (FERC 2246, 362 MW) for hydropower, irrigation, flood control, recreation and fisheries benefits – all in an innovative manner that surpasses the project's original requirements. As a settlement agreement, the Yuba Accord is the final product of nearly three years of intense negotiations among 17 stakeholders, including local irrigation districts, state and federal resource agencies, and conservation groups. Based upon the success of two one-year pilot programs (2006/2007), the State of California approved the agreement in 2008, and it is now fully operational. The Yuba Accord is unprecedented in that it combines increased instream fisheries flows – for wild, native salmon and steelhead – with increased supplemental water supplies for California cities and farms, while preserving all of the project's clean, renewable hydropower generation capacity. The Yuba Accord also reaffirms the water rights of the Yuba County Water Agency and its member irrigation districts. The Yuba Accord represents a nexus of smart engineering, collaborative partnership and strategy development in the pursuit of a sustainable solution to a complex controversy. “

The Accord includes three separate, but inter-related agreements: The Fisheries Agreement, the Water Purchase Agreement, and the conjunctive use agreements. The participants and signatories to the various agreements are shown in Table 4-2, below:

Table 4-2. Yuba Accord Agreement, Signatories and Participants

Entity	Proposed Yuba Accord Agreement			Environmental Compliance Roles
	Fisheries	Conjunctive Use	Water Purchase	
Yuba County Water Agency	Signatory	Signatory	Signatory	CEQA Lead Agency Cost-Share Agency
California Department of Water Resources			Signatory	CEQA Responsible Agency Cost-Share Agency
Bureau of Reclamation			Signatory	NEPA Lead Agency Cost-Share Agency
California Department of Fish and Game	Signatory			CEQA Responsible/ Trustee Agency
Friends of the River	Signatory			NGO
South Yuba River Citizens League	Signatory			NGO
The Bay Institute	Signatory			NGO
Trout Unlimited	Signatory			NGO
National Marine Fisheries Service	Participant ^a			NEPA Cooperating Agency
U.S. Fish and Wildlife Service	Participant ^a			NEPA Cooperating Agency
Brophy Water District		Signatory		Member Unit – CEQA Responsible Agency
Browns Valley Irrigation District		Signatory		Member Unit – CEQA Responsible Agency
Dry Creek Mutual Water Company		Signatory		Member Unit – Private Company
Hallwood Irrigation Company		Signatory		Member Unit – Private Company
Ramirez Water District		Signatory		Member Unit – CEQA Responsible Agency
South Yuba Water District		Signatory		Member Unit – CEQA Responsible Agency
Wheatland Water District		Signatory		Member Unit – CEQA Responsible Agency

^a NMFS and USFWS have signed a Statement of Support for the Fisheries Agreement. Federal law constrains these entities from signing the final Fisheries Agreement.
Source: (YCWA2005)

Source: YCWA, 2007.

4.2.4 Camp Far West Dam and Reservoir

Camp Far West Dam and Reservoir has no designated flood control space and offers only minor, incidental flood attenuation as flood peaks pass through the reservoir.

4.2.5 Forecast-Coordinated Operations

As described in the above paragraphs, the coordinated operation of Oroville and New Bullards Bar reservoirs is required by the USACE reservoir operations practice for both reservoirs. Efforts to improve this coordination have been underway since New Bullards Bar Dam and Reservoir went into operation. These efforts were let to the creation of the Forecast-Coordinated Operations (F-CO) program under FloodSAFE California in 2005. The key elements of the program included the following.

- (1) Improving flood forecasts

- (2) Closely integrating the flood operations of Oroville and New Bullards Bar Dams to minimize peak flood flows on the Feather and Yuba rivers.
- (3) Identifying changes in operational procedures that would improve efficiency
- (4) Providing operators and downstream emergency managers with real-time forecast information including uncertainty bounds associated with the flows at key locations in the flood system

Since the initiation of the F-CO Program the following activities have been completed:

- Preparation of an improved communication protocol between reservoir operators and flood emergency agencies
- Development of sophisticated forecasting models
- Update flood operation protocols for the Yuba and Feather Rivers
- Exercises were conducted to test the agencies' response under the Program

While it is sometimes difficult to quantify the benefits of F-CO, the result of implementing F-CO will be more efficient and reliable flood operation of the reservoirs and better utilization of floodway capacity between the levees with greater confidence that the levees will not be overtopped. Efforts to improve F-CO will continue.

Unfortunately, the New Bullards Bar Dam outlet facilities lack adequate release capacity to take full advantage of the advances in F-CO at present. In addition, releases through Colgate powerhouse, which comprise a small but significant part of the dam's flood release capacity, are compromised when flows in the Middle Fork Yuba River are high. This causes tailwater to rise in the turbine sumps, impacting turbine operations.

4.3 Regional Levees: Descriptions and Hazards

4.3.1 SPFC Facilities

The SPFC levees in the region primarily protect six distinct areas, including the Sutter Basin, Reclamation District 10, Marysville Levee District, Reclamation District 784, Wheatland, and Reclamation District 1001 as shown in Figure 4-4.

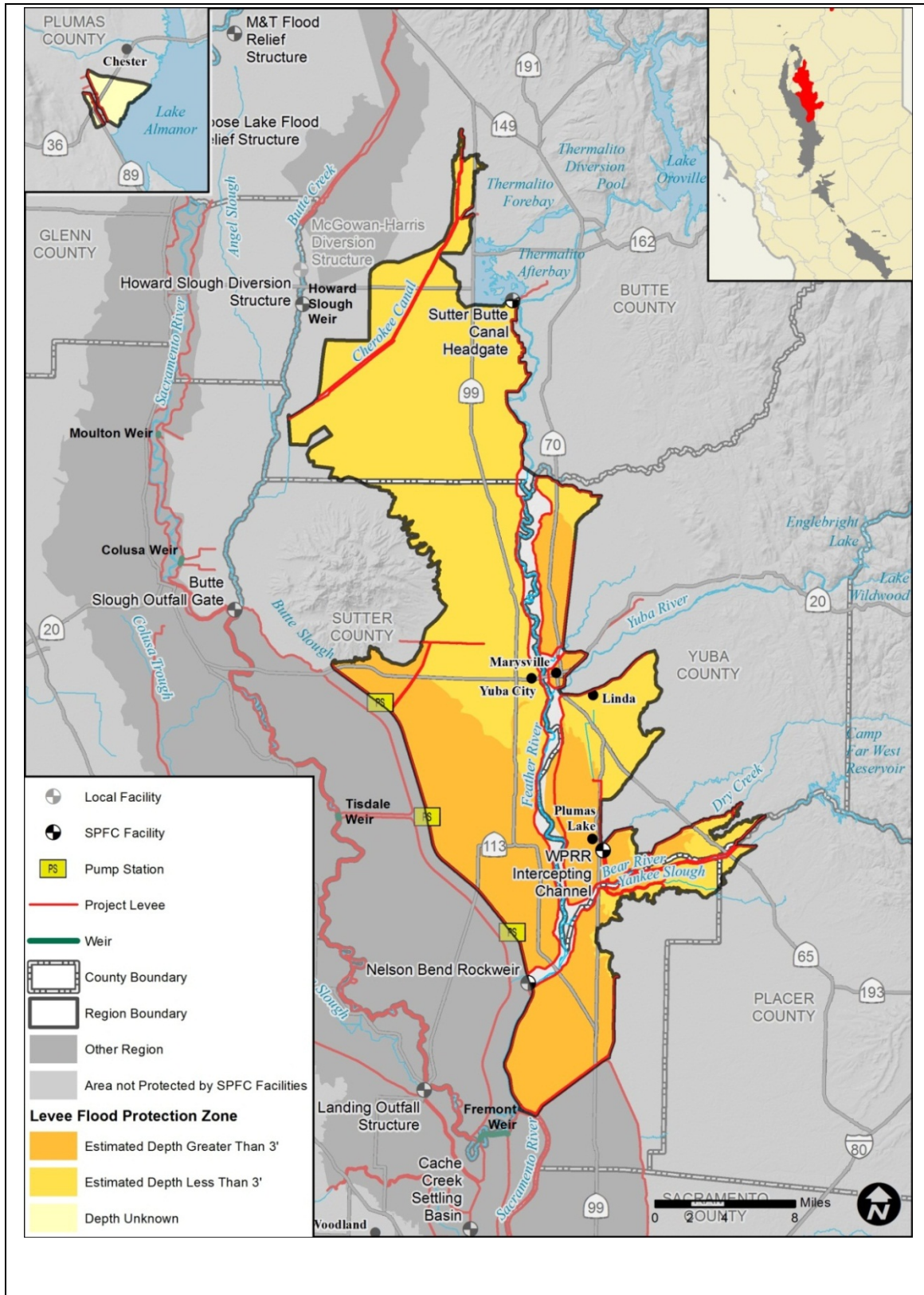


Figure 4-4. Levee-Protected Basins in the Feather River Region
 Source: DWR, 2013. Feather River Region Flood Atlas--Draft

The levees in the region have undergone a series of studies over the years, by USACE, DWR, and local agencies to various levels of detail. DWR compiled available information about these levees in the Flood Control System Status Report (December 2011). As noted in the report, the most recent regional studies were launched by DWR under the FloodSAFE Levee Evaluations Program. This program conducted separate evaluations for urban areas and non-urban areas.

These programs included a review of available geotechnical data, past performance histories, evaluations of levee geometry, and other available data. They also included new geotechnical explorations as appropriate. The Urban Levee Evaluation (ULE) included a more intensive exploration program than the Non-Urban Levee Evaluation (NULE), consistent with the higher risks associated with urban and urbanizing areas. Figure 4-5 differentiates between the urban and non-urban levees in the study area. As the figure shows, the urban levee in the region include the west levee of the Feather River from Thermalito to the Sutter Bypass, portions of the Wadsworth Canal east levee and the Sutter Bypass east levee, the Marysville ring levee, the Yuba River south levee, the Feather River east levee from the Yuba River to the Bear River, and the lower Bear River north levee.

Appendix A includes a detailed discussion of the various evaluations, as well as summaries of the ratings set forth to evaluate the status of urban and non-urban levees throughout the Central Valley Flood Control System.

As described in Section 3.1, the regional levee system has been constructed over many years, of poor, often inadequately compacted materials, placed over permeable foundations, and subject to erosion, seepage, slope instability, penetrations, overtopping, and other potential causes of failure. In general, the overall levee conditions in the region are a cause for concern, except for those reaches that have been recently evaluated and strengthened to meet modern levee standards, as shown in Figure 4-6.

The three recent levee failures in the area, which occurred during the 1986 flood and the 1997 flood, were all due to structural failures rather than overtopping. This is also true of the two breaches that occurred during 1955. Seepage, underseepage, and slope instability may all have contributed to these failures. Overtopping is a concern for Dry Creek near Wheatland. Reaches of the levee briefly overtopped in 1986 and there have been several instances of near overtopping since then including 1997, 2006, and 2012. The only breach on Dry Creek, however, occurred in 1997 and was the result of either through seepage or rodent holes.

Figure 4-6 displays the overall levee conditions in the region. Figure 4-7 indicates the locations of some of the recorded seepage and underseepage concerns, Figure 4-8 identifies areas with slope stability concerns, Figure 4-9 shows past erosion sites, and Figure 4-10 notes the locations of other performance concerns. These figures demonstrate the widespread nature of these risk factors for the regional levee system.



Figure 4-5. Urban (dark brown) and Non-Urban Levees (tan) in the Feather River Region

Source: DWR FCSSR, 2011

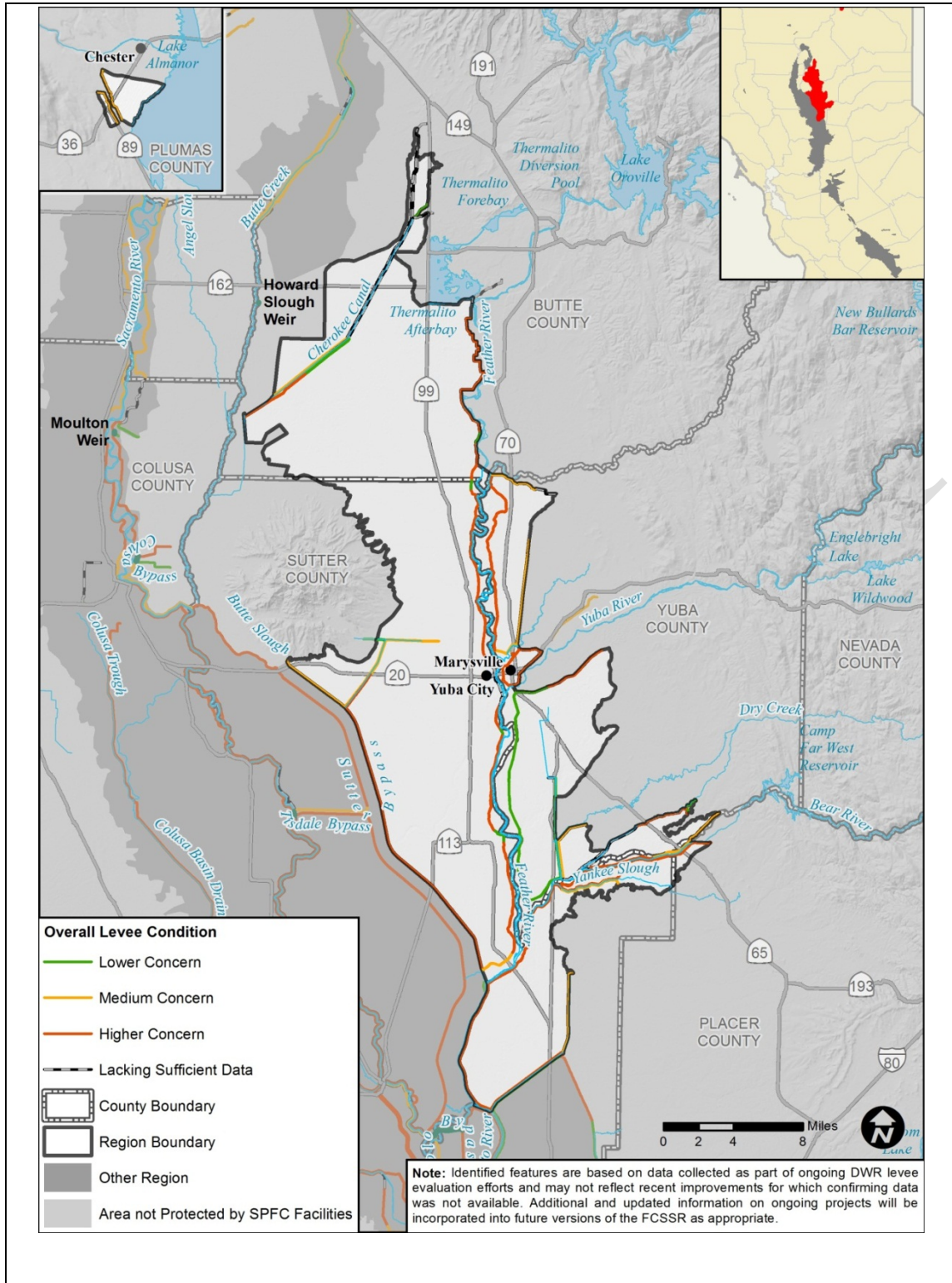


Figure 4-6. Feather River Region, Overall Levee Conditions
 Source: DWR 2013. Feather River Region Flood Atlas-Draft

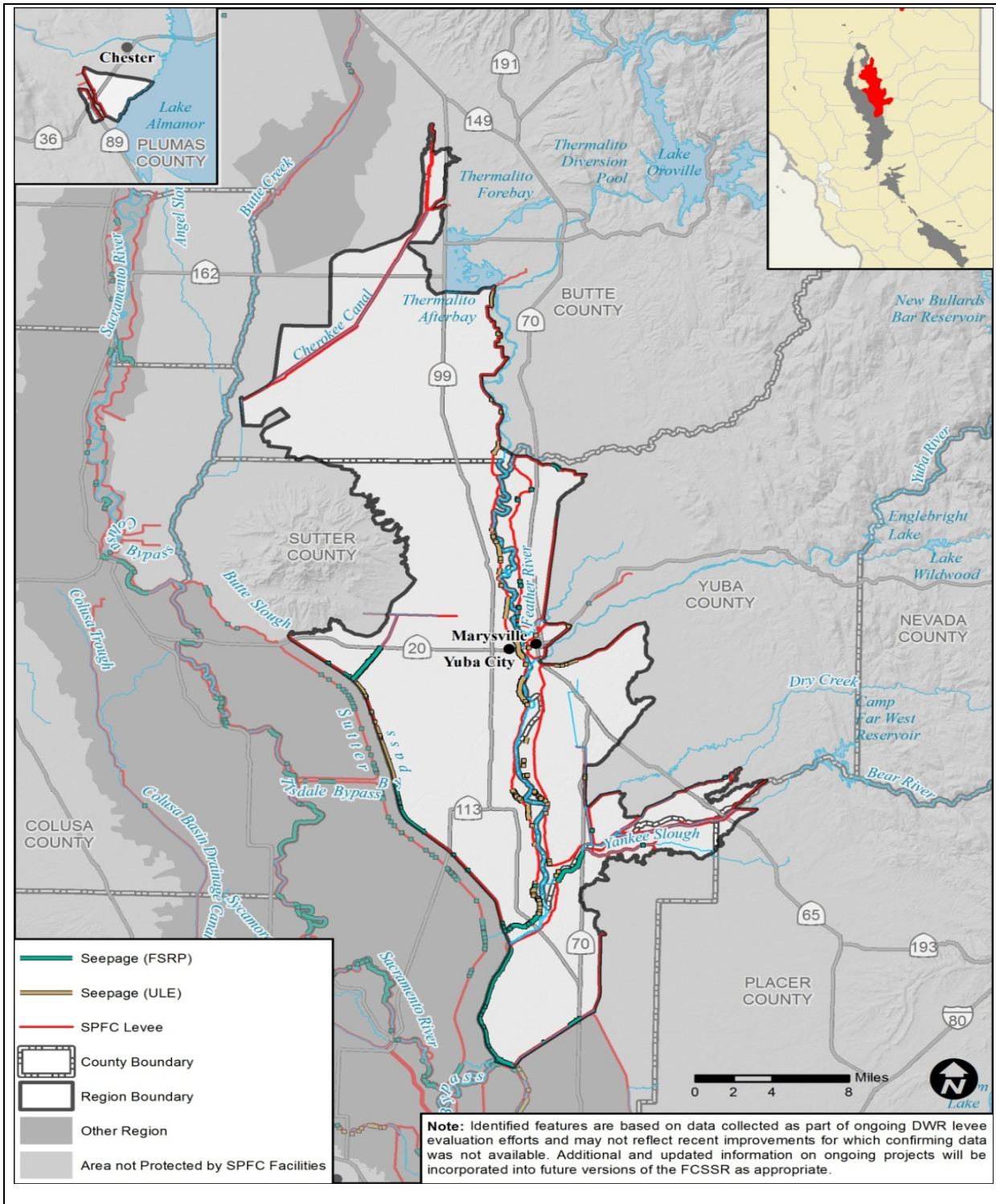


Figure 4-7. Feather River Region Levee Seepage Locations
 Source: DWR 2013. Feather River Region Flood Atlas-Draft

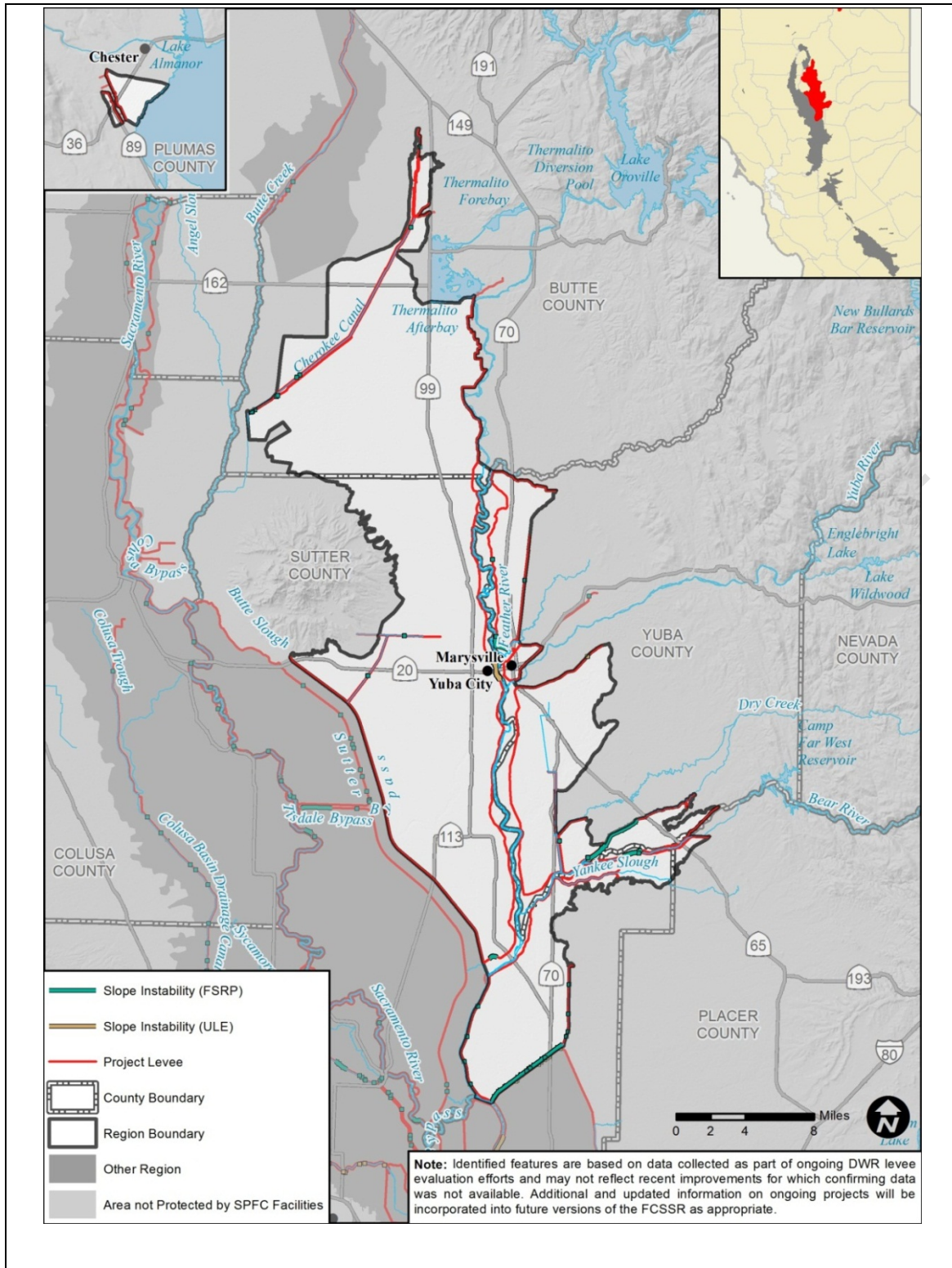


Figure 4-8. Feather River Region Levee Slope Stability Concerns
 Source: DWR 2013. Feather River Region Flood Atlas-Draft

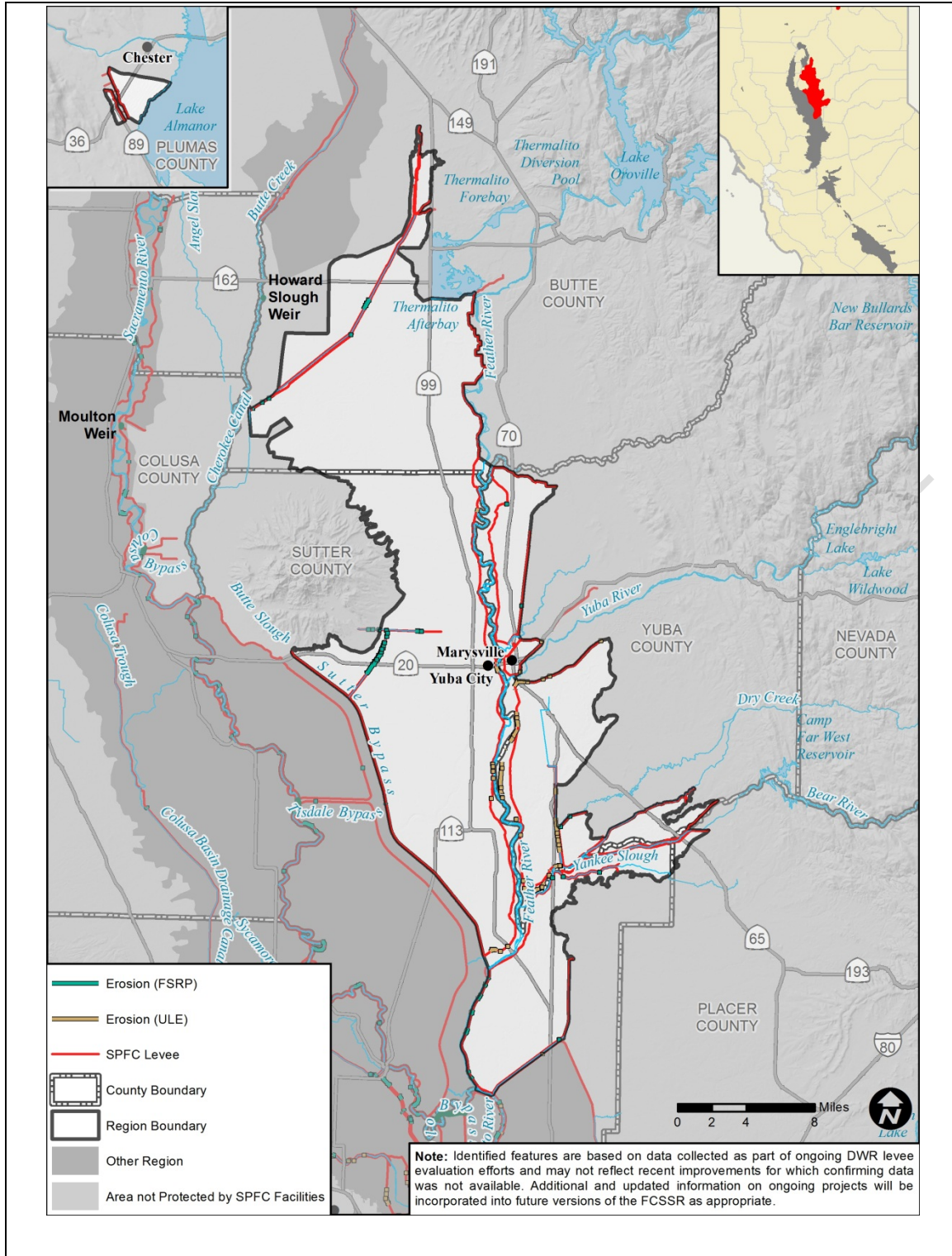


Figure 4-9. Feather River Region Levee Erosion Locations
 Source: DWR 2013. Feather River Region Flood Atlas-Draft

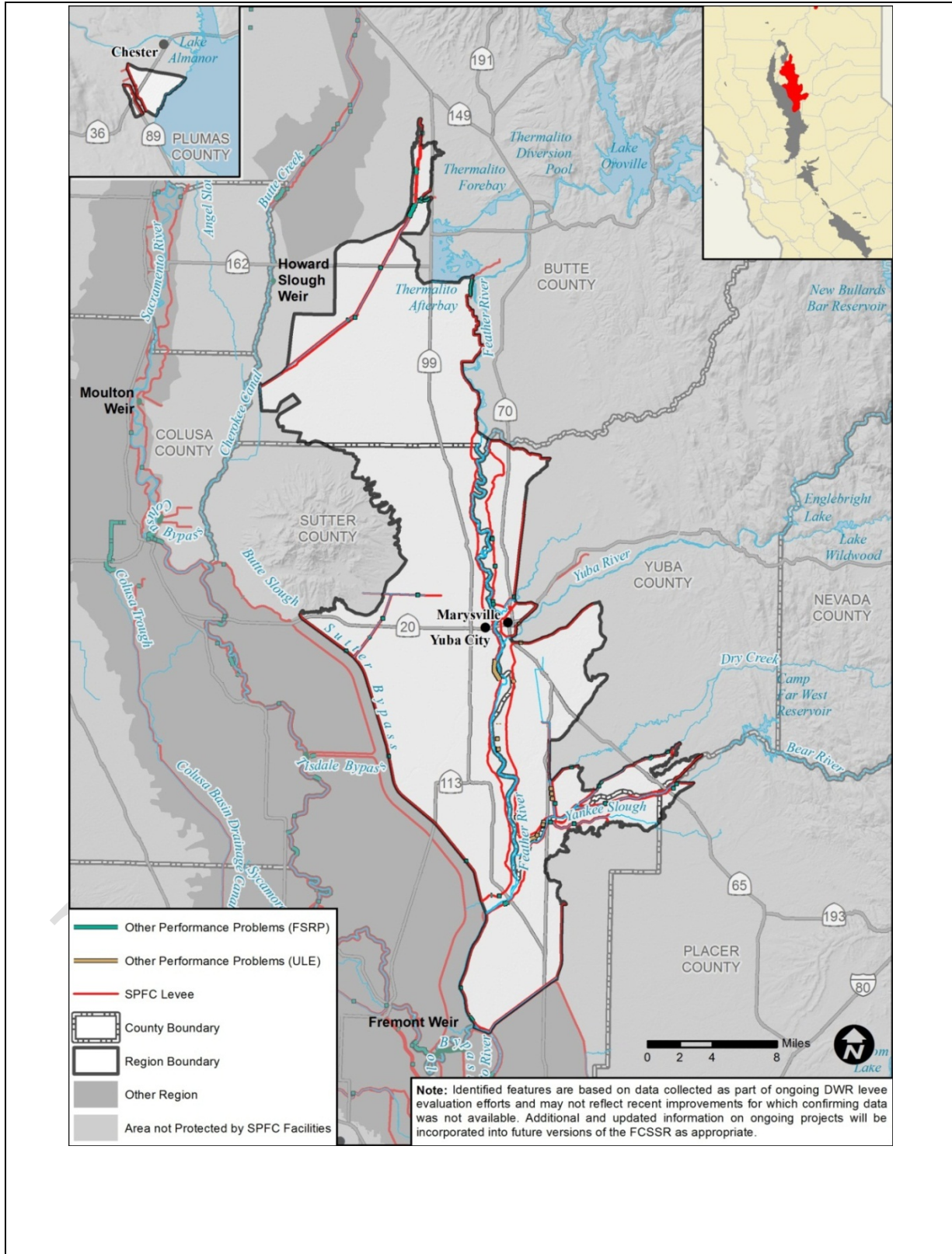


Figure 4-10. Feather River Region Levee Other Performance Problems
 Source: DWR 2013. Feather River Region Flood Atlas-Draft

Additional detailed technical evaluations have been completed or are underway for the Sutter Basin, Marysville, RD 784, and Wheatland. For these areas a great deal of additional technical information is available to describe the condition of the levee systems and the potential failure modes at various locations. RD 10, the Horseshoe area (RD 784 and 817), and RD 1001 have not yet undertaken additional levee risk evaluations due to the rural nature of their levee-protected areas and local funding limitations.

4.3.2 Designated Floodway Levees

“Designated Floodway” as defined in Title 23 of the California Code of Regulations is the channel of the stream or the floodplain required to provide for the passage of a design flood or the floodway between existing levees as adopted by CVFPB or the Legislature. This flood management Plan is focused on the SPFC levees and does not include the designated floodway levees. The designated floodway maps are available on the CVFPB website at <http://www.cvfpb.ca.gov/maps>. These levees are under the jurisdiction of the CVFPB and may be revised if sufficient information is provided to the CVFPB. The board may, at its regularly noticed meeting, make modifications to the designated floodway if it determines that conditions have changed sufficiently to necessitate alterations. The CVFPB may also allow some limited uses if they do not impede flood flows or jeopardize public safety. There are two designated floodways in the Feather River basin, one in Yuba County from the highway 70 bridge to Daguerre Point Dam in Yuba and the other in Butte County from Honcut Creek to Feather River Fish Barrier Dam in Butte County.

4.4 Channels and Floodplains: Physical Characteristics, Hydraulics, Vegetation, Erosion, Sedimentation, Fisheries and Wildlife Habitat, and Maintenance

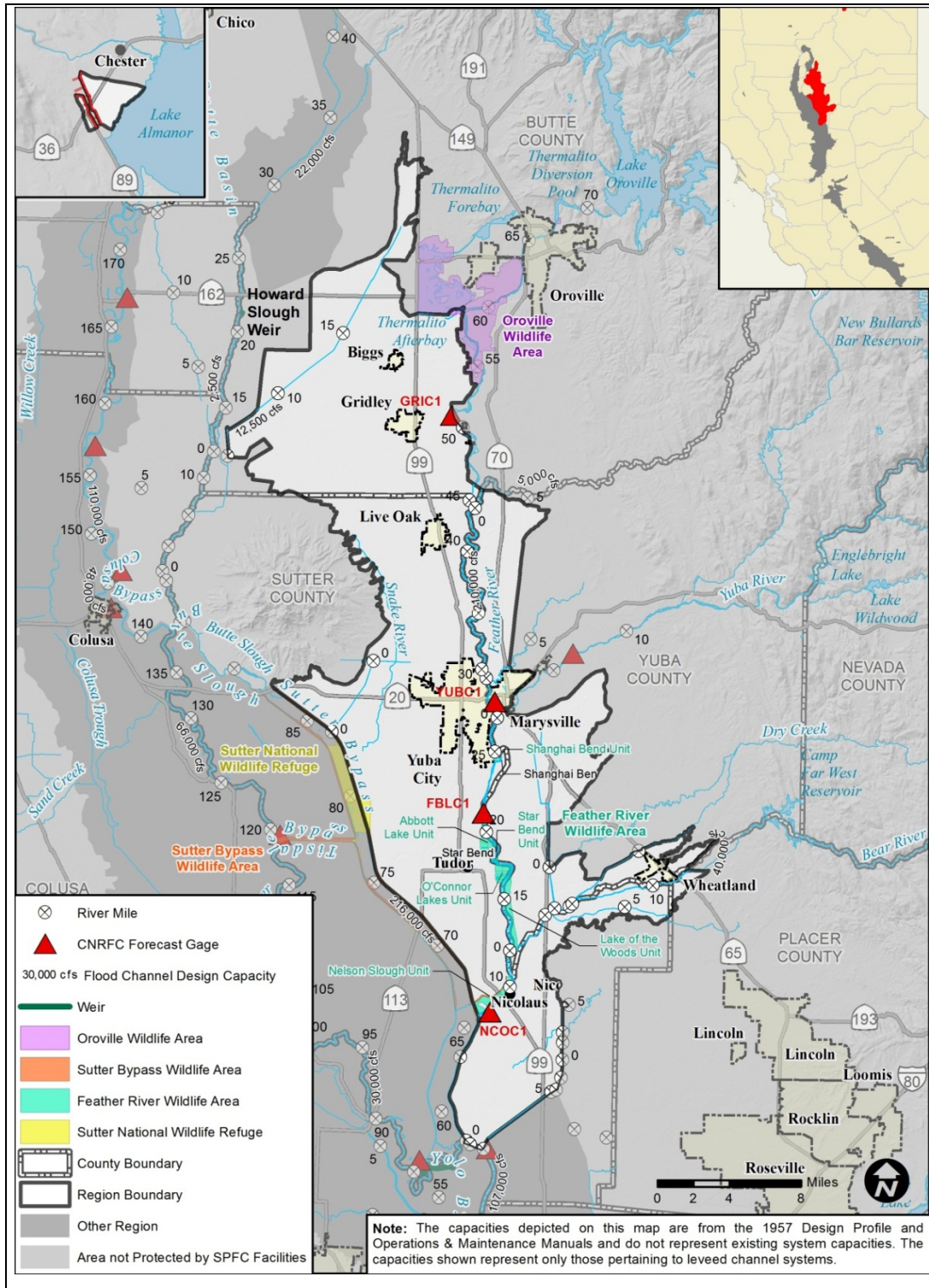
4.4.1 General

The major flood conveyance channels of the region are the Feather River and its tributaries on the east and the Sutter Bypass on the west. As it flows southward from Oroville Dam and Thermalito Afterbay, the Feather River picks up tributary flows from Honcut Creek, the Yuba River and the Bear River before joining the Sutter Bypass at Nicolaus and the Sacramento River at Verona.

The Sutter Bypass primarily conveys flood flows from the Sacramento River via the Butte Basin overflow weirs and swales, Moulton Weir, Colusa Weir, and Tisdale Weir. In addition, drainage from the eastern portion of the Sutter Buttes is conveyed into the Sutter Bypass via the West Intercepting Canal, East Intercepting Canal, and Wadsworth Canal. These channels and their design capacities, as determined by USACE, are briefly described below and shown in Figure 4-11.

The lower Feather River corridor has been extensively studied for the purpose of improving flood protection, fisheries and wildlife habitat, water supply, and other benefits. A great deal of information is available. It is not the intent of this report to summarize this vast body of information, but to provide adequate context for proposed management actions. The interested reader is urged to review reference information for more detail. Of particular relevance is the Lower Feather River Corridor Management Plan (DWR 2014), which provides a wealth of

tabular and graphic information regarding channel geometry, floodplain characteristics, land use and habitat values, recreational facilities, and opportunities.



Source: DWR Regional Atlas, 2013

Figure 4-11. Conveyance Channels of the Feather River Region

4.4.1.1 Overview, Feather River, Thermalito Afterbay to Sacramento River at Verona

The majority of the Feather River between Thermalito and Verona is within a wide floodway with the SPFC levees set back from the active flow channel, with only about five percent of the levees directly adjacent to the active channel. The existing levees along the lower reaches of the Yuba River are also set back considerable distances from the active river channel, except near the Hwy 70 bridge crossing. The slope of the channel is mild, generally paralleling the slope of the valley floor, which varies from about elevation 150 feet mean sea level (msl) at Oroville to about elevation 25 feet msl at Verona.

In general most of the SPFC reaches of the Lower Feather River and its tributaries downstream of Oroville Dam efficiently convey flood flows downstream in relation to the USACE 1957 design flows and accompanying 1957 USACE profile. This also holds true relative to the current 100-year and 200-year design flows that are being utilized for designing flood protection improvements for the urban and urbanizing areas protected in the Feather River Region by the SPFC levee system(s) and bypasses. There are three areas of significant exception to this general rule; limited channel and conveyance capacity is the Sutter Bypass system; the main stem of the Feather River between Star Bend and its confluence with the Sutter Bypass; and the upper reaches of the Bear River and its tributaries, inclusive of Yankee Slough and Dry Creek.

The stretch of the Feather River downstream of the State Route 20 bridge extending down to the confluence with the Sutter Bypass is included in the Lower Feather River Corridor Management Plan (LFRCMP). The LFRCMP is a collaborative component of the CVFPP that is bringing local, regional and State flood control interests together with resources agencies with the goal of concurrently improving and restoring natural habitats for native wildlife and fish species in the Lower Feather River Channel (LFRC) between Yuba City/Marysville and the Sutter Bypass near Nelson Slough while improving the efficiency and effectiveness of channel operation and maintenance processes. This pilot study is striving to establish permitting and mitigation programs that will streamline the environmental consultation process for ongoing flood control and O&M projects.

Figure 4-12, Figure 4-13, Figure 4-14, and Figure 4-15a show the maximum water surface elevation in Feather, Yuba, and Bear rivers.

Feather River between Thermalito and Honcut Creek

Capacity: The USACE 1957 design flow for the Feather River between Thermalito and the Feather River's confluence with the Yuba River near Marysville is 210,000 cfs. The USACE design flow of 210,000, with a safe operational threshold of 180,000 cfs can be conveyed in the Feather River channel and its overflow banks in this reach with more than 3 feet of freeboard on the right bank, (west levee system), except for small isolated locations upstream in the Oroville Wildlife Area (OWA). These same isolated sections of the cobble-covered levee system have overtopped during high flood events, with the last overtopping occurring in 1997. However, this overtopping does not result in significant flood flows escaping from the main channel.

The levee system on the right bank of the Feather River between Oroville and Yuba City was authorized and built in advance of Oroville Dam being constructed. Oroville Dam, which since 1967 has provided a seasonal flood storage pool of up to 750,000 acre-feet, substantially reduces peak flows downstream. The existing levees are constructed to sufficient heights that they have more than sufficient freeboard to contain the 100-year and 200-year events.

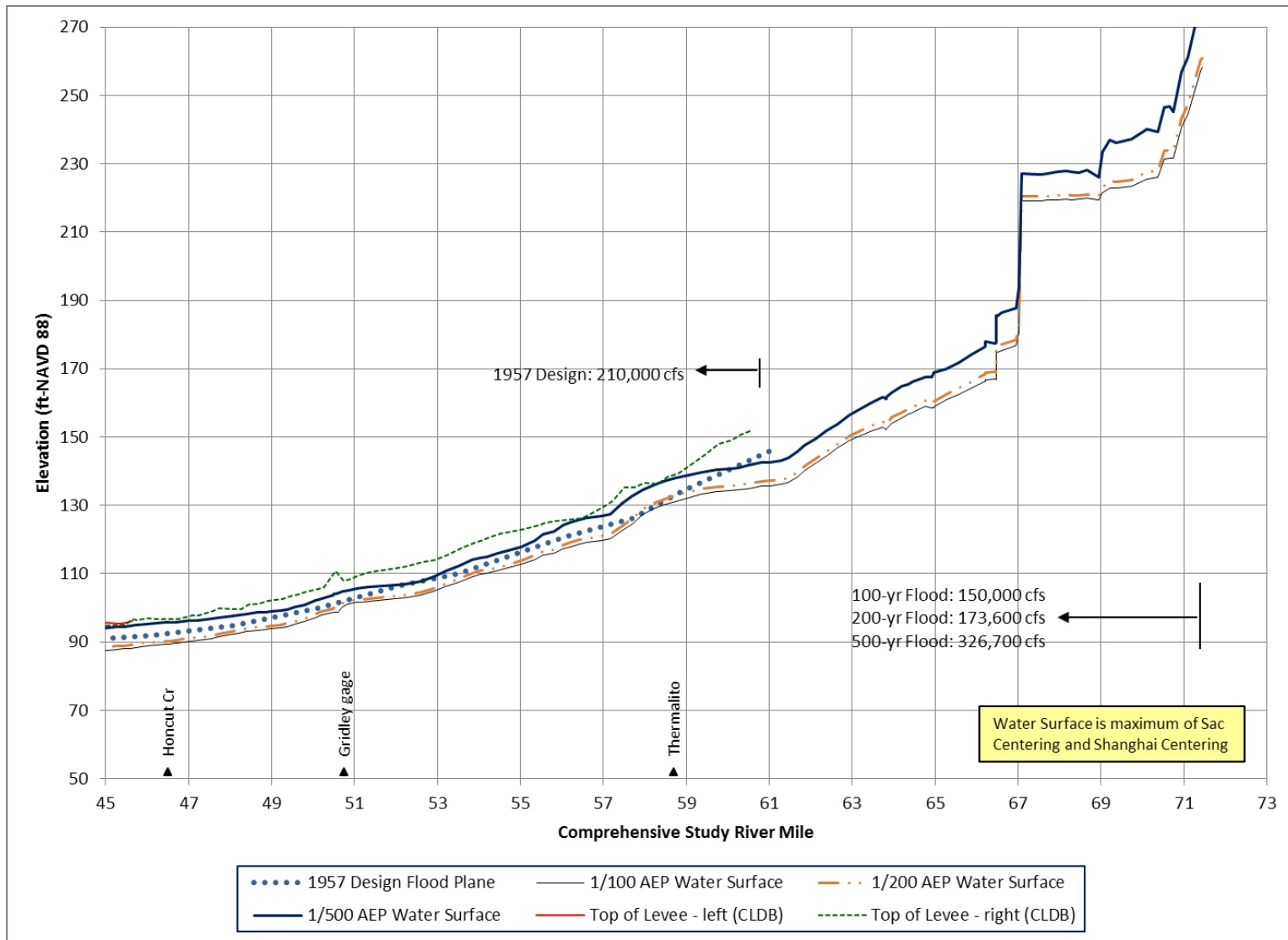


Figure 4-12. Maximum Water Surface Profiles Feather River (above Honcut Creek)

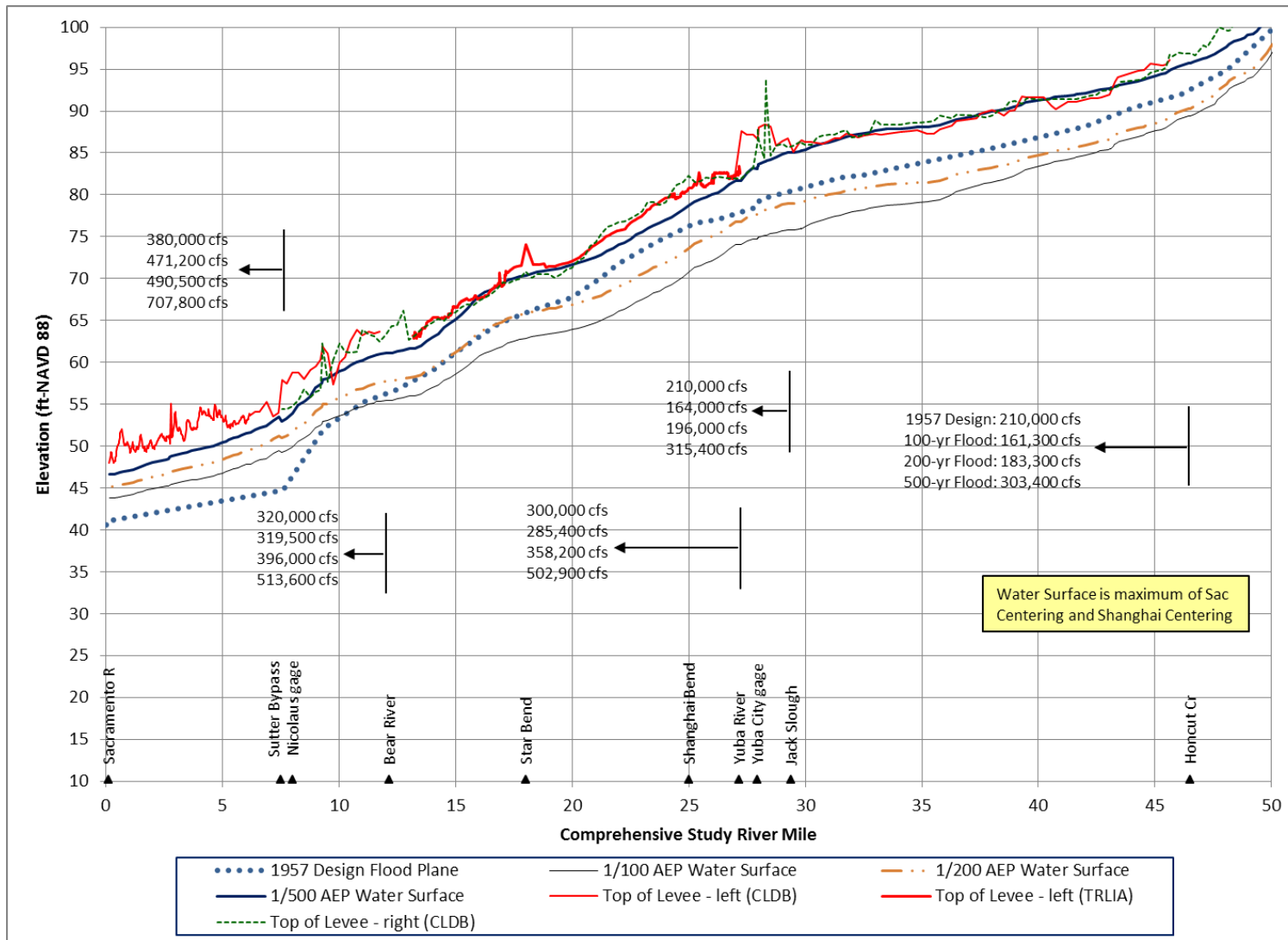


Figure 4-13. Maximum Water Surface Profiles Feather River (below Honcut Creek)

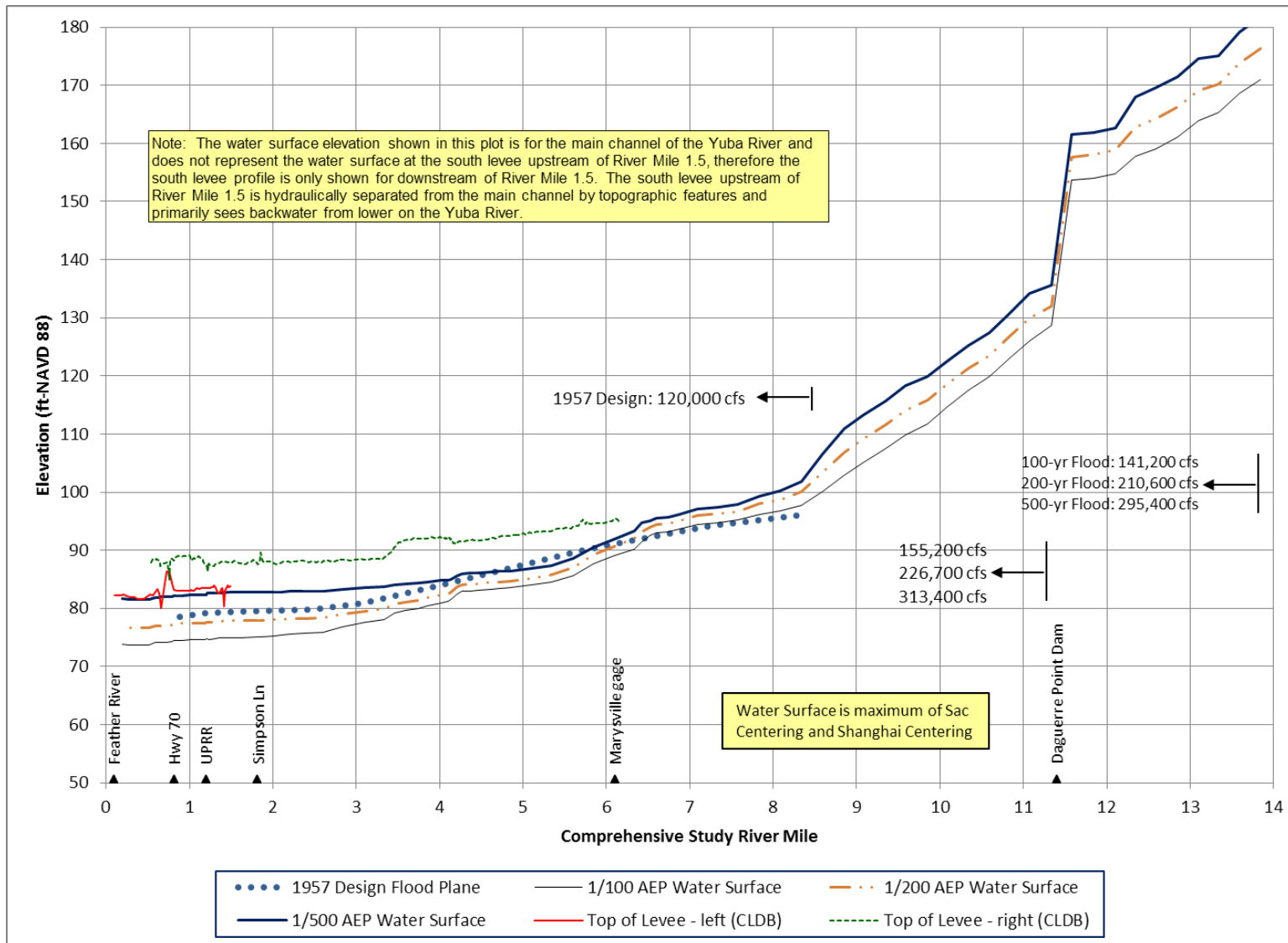


Figure 4-14. Maximum Water Surface Profiles Yuba River

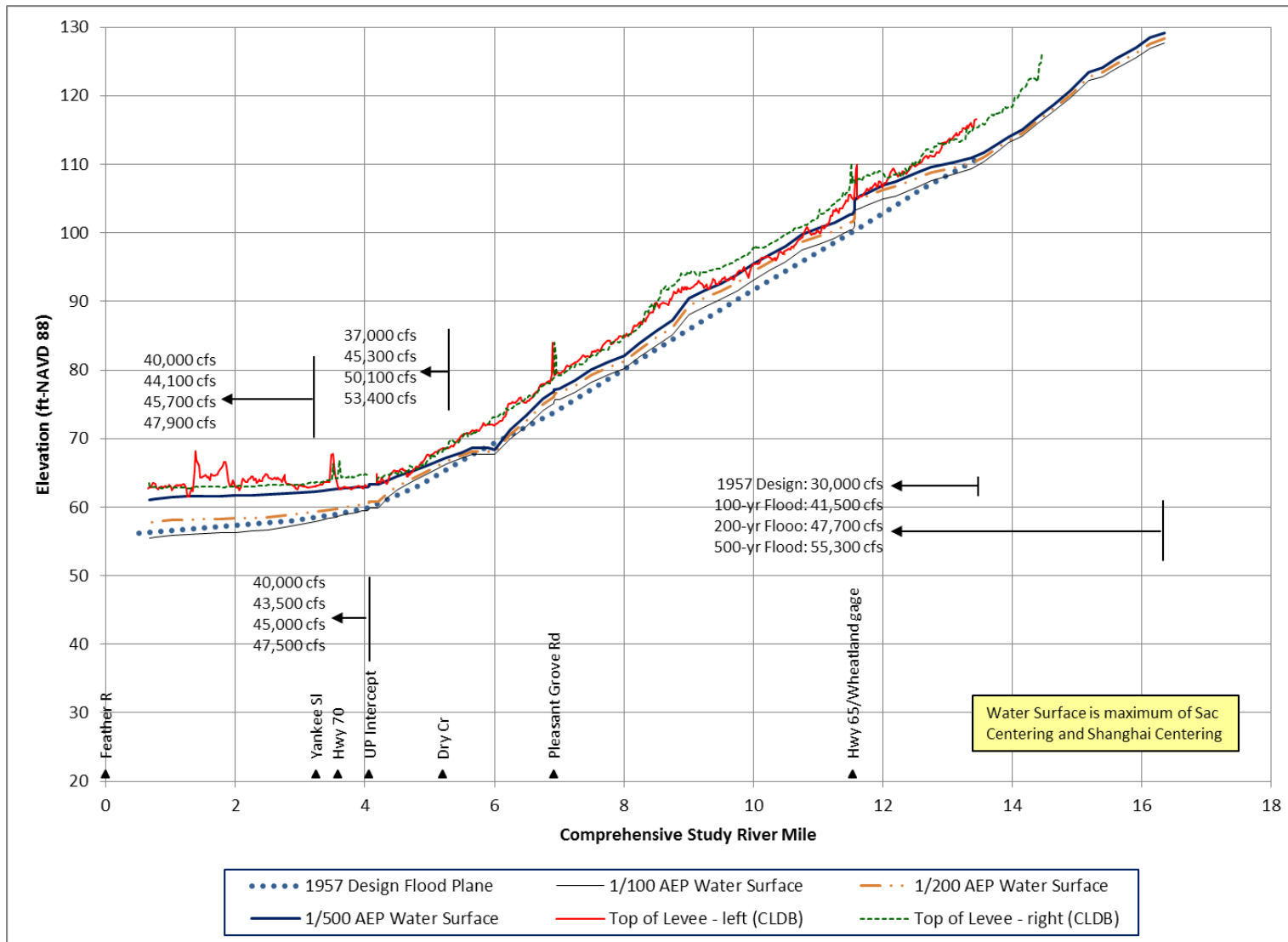


Figure 4-15a. Maximum Water Surface Profiles Bear River

The 100-year design flow currently estimated by the USACE and SBFCA for the reach upstream of Honcut Creek is between 130,000 and 150,000 cfs; the 200-year design flow ranges between 150,000 and 174,000 cfs for the same reach. The design flow depends upon the assumed storm centering, which is highest when the assumed storm center is over the Feather River watershed.

Erosion: There are no areas of significant erosion or slope instability concerns in the upstream reaches of the Feather River between Thermalito and Honcut Creek. The right or west bank of the river channel, particularly through OWA is largely covered with cobbles left from gold dredging operations, with minimal exposure of native erosive soils.

Sedimentation: Due to the close proximity of Oroville Dam and Thermalito Afterbay, which trap all but the finest suspended sediment originating upstream, little sedimentation occurs in this reach of the Feather River and its floodway channel upstream of Honcut Creek.

Vegetation: Native riparian vegetation exists in the reach, but it is sparse and disconnected largely due to large piles of cobbles left from gold dredging in the channel. Vegetation varies greatly, from patches of dense riparian forest to open grasslands and large, nearly barren areas of cobbles.

Maintenance: In the reach of the Lower Feather River upstream of Honcut Creek is no formal levee system along its east or left bank, while the right bank levee system is elevated well above the frequently activated floodplain.

Wildlife Habitat: The wildlife in this reach is varied as the vegetation landscape is abundant, but disconnected in isolated areas and non-existent in others with the landscape heavily populated with mounds of large cobbles present from former dredging and mining operations.

Feather River between Honcut Creek and Yuba River

Capacity: Similar to the upstream reach between Thermalito and Honcut Creek, the SPFC reach between Honcut Creek and the Yuba River was designed by USACE with a 1957 design flow of 210,000 cfs. The USACE design flow of 210,000, with a safe operational threshold of 180,000 cfs, is conveyed in the Feather River channel and its overflow banks in this reach with more than 3 feet of freeboard on the right bank, west levee system. Mapping by the CVFED project is expected to provide updated estimates of the freeboard along the left bank, east levee maintained by RD 10 in this reach between Honcut Creek and Jack Slough, and by the Marysville Levee District between Jack Slough and the Yuba River.

Erosion: There are isolated areas of bank erosion associated with some of large river oxbow bends in the river, but none of the erosion areas currently pose a risk or threat to either the right or left-bank levee systems. However, the large oxbow areas are susceptible to erosion during high flow events along with the leveed areas along both banks of the river as it traverses between the downtown areas of Marysville and Yuba City upstream and downstream of the State Route 20 bridge crossing. These areas are susceptible to potential erosion and require monitoring during and following high stage flooding events.

Sedimentation: This reach of the Feather River receives fines sediments as a result of runoff from the open floodplains. Presence of a mixture of sand, pebbles, and gravels in the channel bed speaks to the composition of the sediments accumulated in the channel.

Vegetation: Native riparian vegetation exists in patches in this reach of the Feather River.

Maintenance: Reclamation District 10 is responsible for maintaining the east bank of the Feather River upstream of Marysville. There is also a ring levee around Marysville which was originally built by local interests and later improved by USACE as project levees. The ring levee is maintained by the Marysville Levee Commission (MLC). RD 784 is responsible for maintaining the Yuba River, Feather River, and Bear River, and Western Pacific Interceptor Canal levees that protect Linda and Olivehurst and adjoining agricultural land.

Wildlife Habitat: There is limited potential for restoration activities in this river reach between Honcut Creek and the mouth of the Yuba River. The majority of the floodway between the levees in this reach is privately owned and intensively farmed, primarily devoted to permanent orchards. There may be limited options in this reach for non-crop buffers or understory plantings in the orchards to provide beneficial raptor habitat, shaded riverine aquatic habitat, and nutrients for fish species. Obtaining conservation easements may be possible as a multi-benefit measure if there are willing sellers in the region. See discussions in Section 7. Portions of the floodway adjoining the low flow channel between Marysville and Yuba City on either side of the State Route 20 bridge crossing are not farmed and may offer significant restoration opportunities. The east bank area extending one half mile upstream of the bridge is occupied by the River Front MX Park, consisting of frequently tilled and graded trails for motorcycle and four wheeler racing.

Feather River between Yuba and Bear Rivers

Capacity: Flood flows in the Lower Feather River Channel segment of the SPFC facilities between the Yuba and Bear rivers are in part controlled by releases from Oroville Dam, operated by DWR, and releases from New Bullards Bar Reservoir, operated by YCWA. Both agencies operate in accordance with criteria established by USACE. The USACE design flow for this reach is 300,000 cfs.

There is ample freeboard of three feet or higher to convey the USACE design flow of 300,000 cfs, well below the USACE 1957 design profile in this segment between the Yuba River to a mile south of Star Bend. However the west or right bank levees in the stretch of river one mile downstream of Star Bend provide less freeboard.

The 100-year design flow of approximately 280,000 cfs and the 200-year design flow of approximately 350,000 cfs can also be conveyed through the noted reach above Star Bend below the 1957 profile with freeboard levels in excess of 3 feet. This is the result of a combination of reservoir controls and additional floodway provided by the recent Star Bend and Feather River setback levee projects.

Erosion: Just south of Star Bend on the Feather River left bank levee is an erosion site on the shelf adjacent to the levee section which is being monitored by RD 784 and USACE. Over the past five years there has been a significant loss of trees and soil from the river bank which is eroding across the shelf towards the levee prism. The clay berm which formed Shanghai falls has been a prominent feature in this section of the river until January 2012, when it collapsed (Appeal Democrat, 2012). This indicates that the Feather River channel is actively eroding in this reach of the river, even affecting resistant features such as this clay berm. One of the potential actions may be to remove cobbles left over from gold dredging and reintroduce it as slope protection where appropriate. In addition, where gravel deposits of the appropriate range of sizes needed by spawning salmon are available, the gravel can be cleaned and re-introduced to the channel to create high-quality spawning habitat.

Sedimentation: The sediments in this reach of the Feather River mostly consist of silt and sand. This fine sediment composition is very similar to the sediments accumulated in the reach north of Yuba River confluence with Feather River.

Vegetation: The freeboard concerns in this reach are exacerbated by dense vegetation in the Lake of The Woods Wildlife Unit of the Feather River, which reduces conveyance capacity. DWR conducts ongoing vegetation management in this area to maintain the current capacity, including the removal of mature riparian vegetation.

Maintenance: The right-bank levee, about 14 miles long, reduces flood risk to Yuba City and adjoining agricultural lands. The right-bank levee is maintained by Levee District 1. The left-bank levee is about 13 miles long. The levee is maintained by RD 784, protecting Linda, Olivehurst, and adjoining agricultural lands.

Wildlife Habitat: There are abundant wildlife populations throughout this portion of the river corridor, including mammals, Swainsons hawks, wild turkey, pheasant, and numerous species of small birds. This area also serves as an important recreational area, including wildlife viewing, hiking, and other activities, which can impact sensitive wildlife species.

Feather River between Bear River and Sutter Bypass

Capacity: The Feather River segment between the Bear River and the Feather River's confluence with the Sutter Bypass near Nelson Slough is managed to convey the USACE design flood flow of 320,000 cfs, including controlled releases from Lake Oroville Dam and New Bullards Bar Dam, and uncontrolled flows from Honcut Creek, Camp Far West Dam, portions of the Yuba River watershed, and local drainage between the Yuba and Bear rivers. Although the Bear River normally peaks earlier than the regulated Feather and Yuba rivers, it contributes sufficient flood flows to the Lower Feather River to bring added stage heights and stresses to the levee systems downstream. The existing levee system provides at least three feet of freeboard for the USACE design flow on the left and right bank levees. Freeboard is also sufficient for the estimated 100-year design flow of approximately 300,000 cfs, which is less than the 1957 design flow in this reach. However, for the 200-year design flow of nearly 400,000 cfs, there is no freeboard in the low spots of the levee crown, particularly along the right bank levee.

Erosion and Sedimentation: The Lower Feather River carries substantial loads of sandy sediments during flood flows, which could significantly reduce the flood carrying capacity of the Sutter Bypass. Nelson weir was constructed in 1970 and 1971 to prevent the Feather River from spilling into the Sutter Bypass, thus retarding such deposition of sediments in the Sutter Bypass during floods (DWR, 1972). It consists of a 900-foot extension of the right bank Feather River levee, a 300-foot training levee, and a 2,200-foot quarry rock dam. One of the potential actions may be to remove cobbles left over from gold dredging and reintroduce it as slope protection where appropriate. In addition, where gravel deposits of the appropriate range of sizes needed by spawning salmon are available, the gravel can be cleaned and re-introduced to the channel to create high-quality spawning habitat.

Maintenance: The right bank levee is 5.2 miles in length and is maintained by Levee District 1 and DWR Maintenance Area 3. The left-bank levee is about 5 miles long and is maintained by

RD 1001. Originally built by local interests, these levees were later enlarged or improved to project standards by USACE.

Vegetation and Wildlife Habitat: This entire reach of the Feather River between the mouth of the Bear River and the confluence with the Sutter Bypass is included in the LFRCMP. The greatest opportunities for future native habitat restoration activities in this segment of the LFRCMP exist with sediment removal and riparian habitat improvements near Nelson Slough, and improved vegetation management practices within the Lake of the Woods Wildlife Area upstream and near the confluence with the Bear River.

Feather River between Sutter Bypass at Nelson Slough and the Sacramento River/Slough at Verona

Capacity: The USACE design gradient in this river reach is relatively flat and drops approximately four feet over its entire length of 7.5 miles. USACE has not established a specific design flow for this section of the Feather River, but the combined conveyance capacity of the Feather River and the Sutter Bypass channels in this reach is 380,000 cfs.

This lower segment of the Feather River channel of approximately 7.5 miles in length between Nelson Slough and the river's confluence with the Sacramento River has an average wetted width of approximately 475 feet, confined by levees approximately 800 feet apart.

Erosion: The Feather River is confined by levees within the Sutter Bypass in this reach. Overflow from the Sacramento River through the Bypass can enter the Feather River in this area and potentially form a backwater. The fast water during high flows can cause erosion. One of the potential actions may be to remove cobbles left over from gold dredging and reintroduce it as slope protection where appropriate. In addition, where gravel deposits of the appropriate range of sizes needed by spawning salmon are available, the gravel can be cleaned and re-introduced to the channel to create high-quality spawning habitat.

Maintenance: RD 1001 maintains the left-bank levee, whereas the right bank levee simply serves as a training levee separating the channels of the Sutter Bypass and the Feather River. It is not maintained as a typical flood control levee and is currently overgrown with woody vegetation.

Vegetation, Sedimentation, and Wildlife Habitat: Vegetation adjacent to the left or east levee is not of particular concern in this reach, nor is vegetation on or near the training levee that separates the Feather River channel from the Sutter Bypass. However, there has been concern of sediment build-up in this section of the River and in the adjoining segment of the Sutter Bypass. To address sediment deposits in this reach and a combined sediment trap, removal and habitat restoration program is being explored by the LFRCMP upstream at Nelson Slough, just downstream of the State Route 99 bridge crossing. This program includes a combination of planting riparian forest and oak woodland, planting perennial grassland and oak savannah, and excavating sediment combined with planting to create SRA.

Honcut Creek

Honcut Creek drains into the Feather River from the east about halfway between Oroville and Marysville. It drains a watershed of approximately 200 square miles, accounting for about 25% of the Lower Feather River Watershed. It contains about 72 miles of major stream channels, including North Fork Honcut, South Fork Honcut, and Wyandotte (Sutter County Resource Conservation District, 2009).

Capacity: A project levee confines Honcut Creek along the left bank for 4.5 miles between Honcut Creek and its confluence with the Feather River.

The USACE 1957 design flow for this partially leveed section of Honcut Creek is 25,000 cfs, which compares closely with the current 100-year design flow estimate of 26,900 to 27,900 cfs. The 200-year design event is currently estimated between 32,100 and 33,400 cfs.

Erosion: The flows in the Honcut Creek vary depending on seasonal storms ranging from peak flows in winter to potentially a dry creek in summer time. The erosion is typically due to high flows and expected to increase as the intensity of winter storms become more severe. One of the potential actions may be to remove cobbles left over from gold dredging and reintroduce it as slope protection where appropriate. In addition, where gravel deposits of the appropriate range of sizes needed by spawning salmon are available, the gravel can be cleaned and re-introduced to the channel to create high-quality spawning habitat.

Sedimentation: Honcut Creek is the only tributary providing gravel/cobble-sized sediment to the river between Oroville Dam and Yuba City with Oroville Dam blocking the natural recruitment and conveyance of gravels and cobbles from upstream of Lake Oroville.

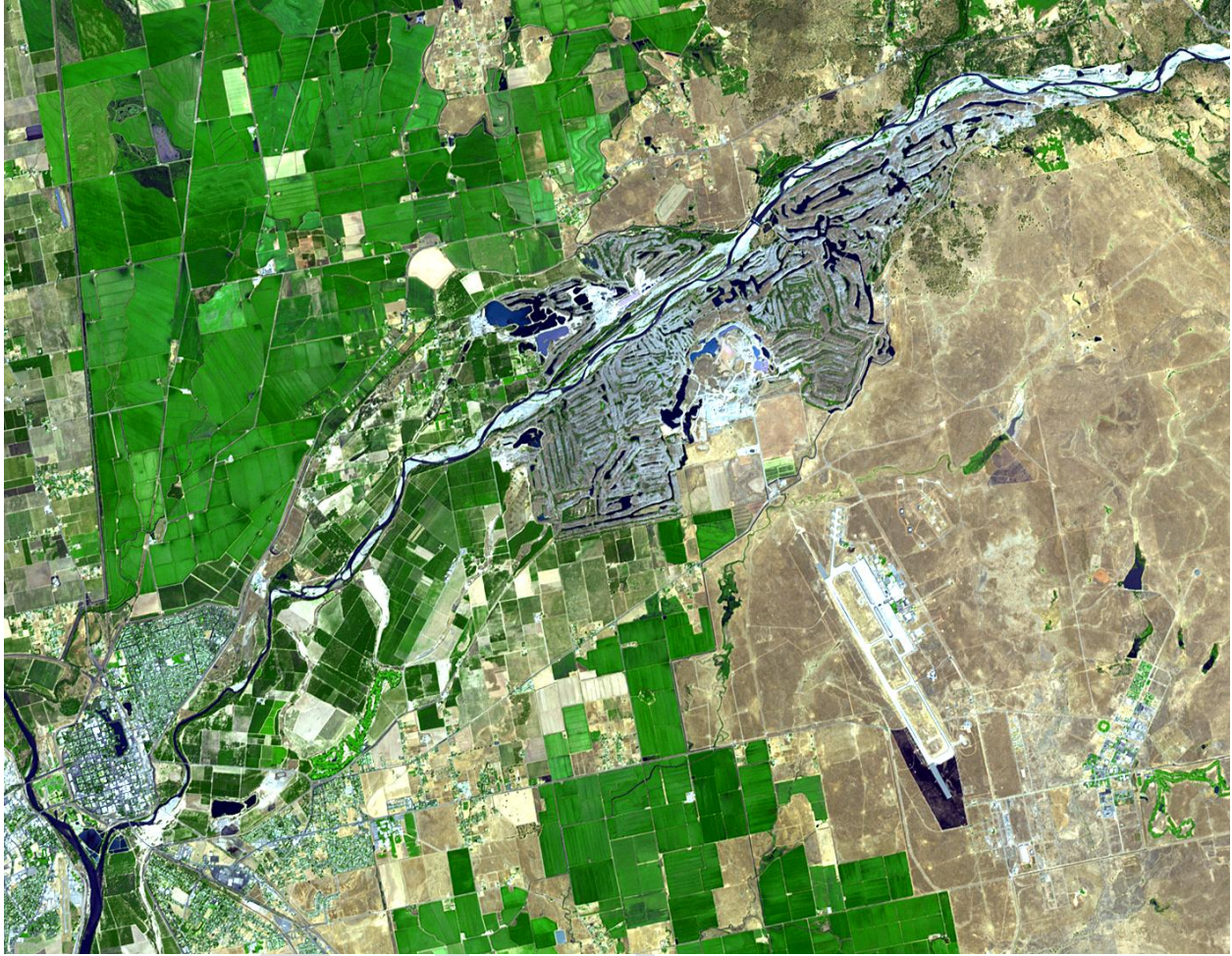
Vegetation: NRCS conducted a riparian corridor habitat assessment for Honcut Creek and its tributaries in 2009, using available GIS data supported by a two-day field assessment. The study focused on the major stream channels and a 100-foot buffer strip on each side of the stream centerlines. A total of 72 stream miles were mapped, including 1703 acres, of which 70 percent was native vegetation, 5 percent was in agricultural use, and the remaining acreage was attributed to water surface, barren, and some urban residential use (NRCS, 2009). The majority of native vegetation was categorized as Cottonwood Willow Riparian Forest, Valley Oak Riparian Forest, and Willow Scrub. In addition, significant portion of the Wyandotte Creek corridor was Managed Wetland (19 percent of total buffer) (NRCS, 2009).

Maintenance: The 4.5 miles of project levee along the left bank of lower Honcut Creek is maintained by RD 10.

Wildlife Habitat: The riparian corridors along Honcut Creek and its tributaries provide essential habitat for a wide variety of resident and migratory species. They are especially important as breeding and stopover sites for the many Neotropical migrant birds that use the Central Valley flyway (NRCS, 2009).

4.4.1.2 Yuba River

The current characteristics of the lower Yuba River have largely been shaped by the effects of hydraulic mining upstream and subsequent dredging of placer deposits and accumulated hydraulic mining debris. The Yuba River received immense sediment loads from hydraulic mining upstream. At the mouth of the Yuba River, just south of Marysville, 70 feet or more of sediment filled the river channel, and upstream of Marysville, whole communities were buried under more than 40 feet of silt and Gravel (Yuba County, 1994). In 1893 the California Debris Commission began to dredge the Yuba River to help restore channel capacity, beginning at the mouth and moving upstream. The dredged materials were deposited in piles within the expanse of the river floodplain (Wikipedia-Yuba Goldfields, 2014). The 10,000 acres of mining debris and alluvial deposits about 10 miles upstream of Marysville were mined for gold from about 1903 to 1968, reworking about one billion cubic yards of material, to create the channel landscape which remains today (Figure 4-15b) (Asterweb, accessed 3-29-14).



Credit: NASA/GSFC/METI/Japan Space Systems, and U.S./Japan ASTER Science Team, Photo taken August 29, 2001

Figure 4-15b. Lower Yuba River Channel with Goldfields

Capacity: The channel capacity of the Yuba River upstream from its confluence with the Feather River was originally 120,000 cfs and later upgraded to 180,000 cfs. The water control manual for the upstream New Bullards Bar Dam specifies a maximum flow of 180,000 cfs for the Yuba River. SPFC facilities include right- and left-bank levees.

Erosion: Monitoring of the lower Yuba River channel over time has shown that the river channel sediment wave deposited as a result of hydraulic mining peaked about 1906. Since then the river channel has been degrading and eroding laterally (Figure 4-15c), with a net decrease in thalweg elevation of about 32 feet between 1906 and 1979 (Burt, Tim and Robert Allison, 2010).



Source: Michael Singer

Figure 4-15c. Eroding Bank along the Lower Yuba River

The process is expected to continue. If unconstrained, the lower Yuba River would take thousands of years to fully erode the sediment, but much of the lower Yuba River channel is lined with levees engineered to resist erosion (Burt, Tim and Robert Allison, 2010). The sediment in the lower Yuba River is laced with mercury, used during the gold mining era to capture gold during hydraulic mining and placer mining. Mercury is mobilized along with sediment during large flood events, resulting in elevated mercury spikes as far downstream as San Francisco Bay (Main, 2013).

Sedimentation: Most sediment generated within the Yuba River watershed is now captured by various dams, most notably Englebright Dam, which captures most sediment generated by the North Fork Yuba River, Middle Fork Yuba River, and South Fork Yuba River. Deer Creek enters the lower Yuba River downstream of Englebright Dam, and thus provides a significant source of sediment. Deer Creek received large volumes of sediment during the hydraulic mining period, but its sediment deposits are unimpeded by on-stream dams. Analyses of the available flow and sediment yield records suggest that the stream is transport-limited with abundant erodible sediment (James, 2004). The combination of sediment carried by Deer Creek and mobilization of sediment in the lower Yuba River during major flood events combines to make the Yuba River a major source of sediment for the Lower Feather River and the Sacramento

River, an effect which is likely to continue for centuries. However, double mass plots of sediment yield suggest that the yield is diminishing over time (James, 2004).

Vegetation: A dense riparian forest ranging in width from one mile to three miles existed along the lower Yuba River prior to 1849. The current vegetation in the lower Yuba River reflects the many effects of human disturbance which began in 1849, including cutting and clearing of the forest for fuel and farmland, hydraulic mining debris deposition, reworking of the debris for additional gold removal, dam construction, and development. DWR has mapped the vegetation in the Yuba River corridor from the Feather River to the Goldfields, a distance of about 7 miles. This portion of the lower Yuba River includes 8,277 acres, of which 4890 acres are in agricultural use (mostly orchard and vineyard), 1540 acres are developed, 1,617 acres are natural vegetation, and 230 acres are open water (DWR, 2011c). From the Goldfields upstream to Parks Bar the river channel and floodplain consist primarily of hydraulic mining debris with riparian scrub and riparian forest along current and former water courses. This vegetation is relatively sparse and intermittent. In 2010 a field survey was conducted in the reach from Parks Bar, which is the approximate upper end of the Yuba River alluvial plain, to Hammon Bar, a distance of about four miles (CBEC 2010). The field survey findings were summarized as follows:

“Initial field observations indicated that riparian plant cover on surfaces away from the summer baseflow water edge is low, connectivity between older riparian patches and younger patches is low and that species and structural diversity are low throughout most of the study reach as compared to riparian zones of similar Central Valley Rivers. The dominant plant species within riparian vegetation stands along the mainstem are predominantly shrub forming and grow to heights less than 20 ft. Specifically, narrowleaf willow (*Salix exigua*), dusky willow (*S. melanopsis*) and white alder (*Alnus rhombifolia*) were observed to be growing in dense semi-continuous bands along the summer baseflow channel margin where shallow riparian groundwater can be sustained by near constant streamflows. These bands comprise the prevalent riparian vegetation pattern reflective of the contemporary hydrologic regime. Woody plant species that grow higher than 30 ft are uncommon along the mainstem. Infrequently within the narrowleaf-dusky willow patches an occasional individual Fremont cottonwood (*Populus fremontii*), red willow (*S. laevigata*), shiny willow (*S. lucida* ssp. *lasiandra*), ash (*Fraxinus latifolia*), or box elder (*Acer negundo*) may be found. Small, isolated stands of structurally diverse, mature vegetation dominated by older Fremont cottonwood were observed growing as patches around the mainstem where tributary confluences or remnant dredger swales maintain access to shallow riparian groundwater. These older riparian vegetation stands have greater structural, species and age diversity, than younger more recently recruited woody riparian vegetation. Cottonwood trees, which could grow in excess of 120 ft, are largely absent near the channel where they could be recruited as large wood during channel migration or bank undercutting. Few younger classes of Fremont cottonwood were observed. No valley oaks (*Quercus lobata*) were observed within the project reach riparian corridor.”

Maintenance: The right-bank levee extends about 6.9 miles upstream from the Marysville ring levee. The levee is maintained by the Marysville Levee Commission and includes two miles of patrol road levee from Highway 20 at Walmart Avenue to Hallwood Boulevard to provide an emergency escape route during high flows (Yuba County 2007.YC MHMJHMP-annex A-2).

The left-bank levee extends about 6.1 miles from high ground to the confluence connection with the Feather River levees. The levee is maintained by RD 784.

Wildlife Habitat: Within the lower six miles of the Yuba River corridor DWR has mapped the various wildlife habitat types, including Shaded Riverine Aquatic Cover (SRA), Riparian Habitat, Marsh and Other Wetland Habitat, and Floodplain Agriculture. About 44 percent of the streambanks are lined with SRA. Less than 690 acres of riparian vegetation is located within a mile of the river channel, about 8 percent of the corridor land area. The corridor includes about 11 acres of Marsh and Other Wetland Habitat. Nevertheless, sensitive species have been documented in this reach, including Swainson's hawk, tricolored blackbirds, and western yellow-billed cuckoo (DWR, 2014a unpublished).

The river continues to support naturally spawning fall run and spring run salmon, as well as steelhead. Among Central Valley Rivers, the Yuba is uniquely valuable for the persistence of all three runs without the direct support of a hatchery. Wild spawning salmon and steelhead in the Yuba River are protected in part by flow schedules currently prescribed by the Yuba Accord. The estimated spawning population of Fall-run Chinook salmon in the Yuba River averaged 15,000 over recent decades, but ranges from 7,371 to 14,908 over the last three years (YCWA, 2014).

4.4.1.3 Bear River and its Tributary Channels (WPIC, Dry Creek, and Yankee Slough)

The lower Bear River runs from Camp Far West Reservoir 16 miles to the confluence with the Feather River at the 23 foot elevation. One mile downstream of Camp Far West Dam, at River Mile 15, is a diversion dam operated by the South Sutter Water District. The diversion dam moves Bear River water into the South Sutter Canal and the Camp Far West Canal located, respectively, on the south and north sides of the river. Dry Creek runs through the Spenceville Wildlife Area and into the Bear below Wheatland. Yankee Slough, from the south, and Best Slough, from the north, enter the Bear just below the confluence with Dry Creek. (Foothills Water Network, 2014).

The Foothills Water Network (2014) notes:

“The lower Bear also continues to support remnant and/or “stray” wild and/or hatchery-sustained salmon, and in the past it supported both steelhead and sturgeon as well. The USFWS's Central Valley Project Improvement Act Tributary Production Enhancement Report of May 1998 identifies “Instream flows, high water temperatures, unscreened diversions, poor water quality, partial or complete migration barriers and illegal harvests are factors limiting salmon and steelhead migration, spawning, incubation and rearing success in the Bear River” (p. 4-57). Depleted flows and excessive temperatures also have negative impacts on the trout fishery. In addition, constricted channels in Bear Valley and on the lower Bear at the confluence with the Feather also harm the fisheries, as do gravel mining operations between Rollins and Combie. Depleted flows and high water temperatures are the greatest constraint to instream habitat quality today. Estimates of natural (unimpaired) runoff from 1929-94 average more than 300,000 AF/year (= 418 average cfs) in the lower Bear below Wheatland. Medians flows over approximately the same period average only 21cfs. By comparison, State Water Resources Board records list 28 registered diverters in the basin that account for up to 8,362.5 cfs of potential water diversions. Overall, the volume of recognized diversions greatly exceeds the natural runoff of the watershed. The present system of diversions also results in rapid

fluctuations in flow that are much harder on the riverine habitat and fisheries than the more gradual natural seasonal variations.”

“The Bear River was far more heavily impacted by hydraulic mining (i.e., tons of mining sediment per unit of drainage area) than the Yuba or American Rivers. Approximately 271 million cubic meters of hydraulic mining sediment were released over the 31 year period of heavy hydraulic mining (James, 2004). It is estimated that 125 million cubic meters (160 million cubic yards) of mining sediment is still stored in the lower Bear. The high volume of mining sediment, in combination with restricting levees, has caused the lower Bear to change from wide and shallow to deeply incised. The river is listed under Section 303(d) of the Clean Water Act for mercury (primarily in reservoirs and Greenhorn Creek) and diazinon (between Camp Far West and the Feather) (Foothills Water Network, 2014).”

In 2005 TRLIA initiated a project to set back the right bank levee of the lower Bear River was set back for a distance of approximately 9600 feet, beginning near the confluence with the Feather River. The project, now completed, restored approximately 395 acres of agricultural land to the active floodplain, with the multi-objective goals of reducing the risk of flooding for RD 784, improving system flood conveyance and active floodplain storage, and improving fisheries and wildlife habitat. Native trees and shrubs were planted in the new setback area to enhance wildlife habitat (TRLIA, 2014).

Capacities: SPFC facilities in the Bear River watershed include levees along Dry Creek and the Bear River, which meet west of Wheatland, the Western Pacific Railroad (WPRR) Intercepting Channel, which diverts local stream flows southward east of RD 784, and Yankee Slough, which enters the Bear River from the south near Rio Oso. Upstream from its confluence with Dry Creek, the Bear River design channel capacity is 30,000 cfs. Dry Creek has a currently estimated design channel capacity of 7,000 cfs based on O&M manuals. This differs from the design capacity of 9,000 cfs estimated in the 1957 Revised Profile Drawings (USACE, 1957a). The design capacity of the WPRR Intercepting Channel is 10,000 cfs, based on the O&M manual. Yankee Slough has a design channel capacity of 2,500 cfs. The Bear River has a combined capacity of 40,000 cfs at the confluence with the Feather River.

Erosion: Erosion within the leveed channel of the lower Bear River is continuing, particularly during major flood events. For example, topographic surveys before and after the 1986 flood on the lower Bear River documented an increase in channel cross section of 882 square feet, with an estimated release of 82,000 cubic meters of sediment (James, 2004). Ongoing erosion also affects levees along the lower Bear River, as has been noted in periodic USACE reports. One of the potential actions may be to remove cobbles left over from gold dredging and reintroduce it as slope protection where appropriate. In addition, where gravel deposits of the appropriate range of sizes needed by spawning salmon are available, the gravel can be cleaned and re-introduced to the channel to create high-quality spawning habitat.

Sedimentation: As described above, sedimentation is not a concern in the lower Bear River channel. Camp Far West Reservoir intercepts all but the finest sediments from upstream and the river is continuing to erode hydraulic mining sediments.

Vegetation: As with the lower Feather River and lower Yuba River, before the gold rush the lower Bear River and Dry Creek corridor supported dense stands of riparian forest, ranging in width from one to three miles, up to the lower foothills (Thompson 1961). At present most of

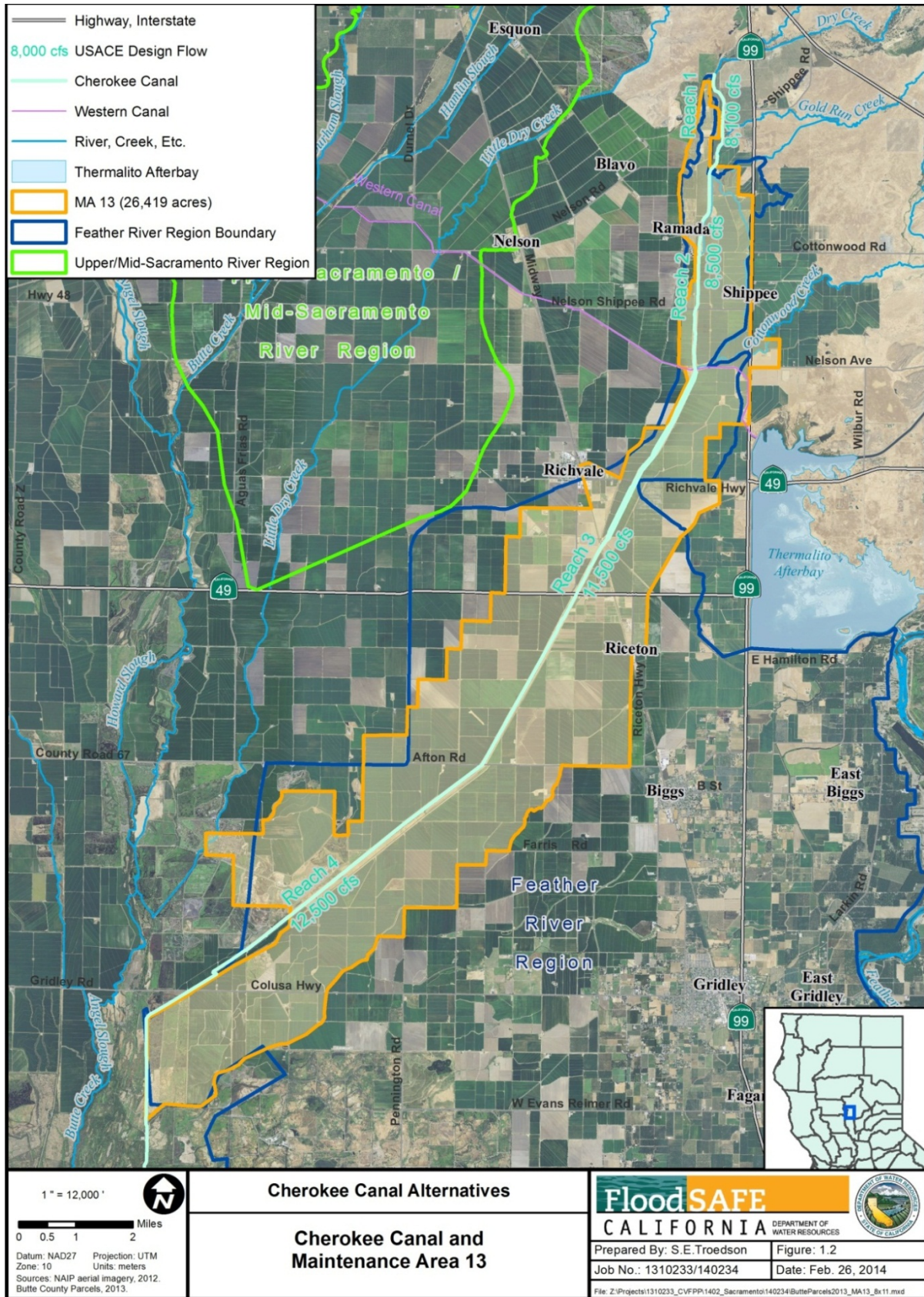
the vegetative cover of the lower Bear River floodplain between the confluence with the Feather River and Highway is identified in the draft Lower Feather River Corridor Management Plan (DWR, 2014, unpublished) as dense riparian forest, with lesser amounts of perennial grasslands, and minor segments of freshwater marsh. Google Earth imagery for this area obtained in August 2013 shows a band of mature riparian forest about 300 feet wide centered on the main river channel, surrounded by young planted vegetation. Upstream of Highway 70 the main river channel is also lined with riparian forest, surrounded by grasslands and mixed woodlands with a high concentration of elderberry. Orchards make up a significant portion of the river terrace between Highway 70 and the confluence of the Bear River and Dry Creek.

Maintenance: The complex system of the Bear River drainage is maintained by several LMAs. RD 817 and RD 2103 maintain the levee system which protects the Wheatland area from the Bear River and Dry Creek. RD 784 and RD 817 are responsible for the levees which define the Horseshoe area between the Bear River and Best Slough, east of the WPRR Intercepting Canal. RD 1001 maintains the Bear River left-bank levee, from high ground to the Feather River confluence, which protects Nicolaus, East Nicolaus, and Rio Oso, as well as the agricultural lands and infrastructure within RD 1001 boundaries.

Wildlife Habitat: The lower watershed is dominated by grasslands and agricultural production. There are numerous species of mammals and birds, including migratory birds in this area, including the farm lands adjacent to the river corridor. Rare, sensitive, threatened and endangered species occurring in the watershed include Chinook salmon, Giant garter snake, Northwestern pond turtle, California horned lizard, Willow flycatcher, Foothill yellow-legged frog, Valley elderberry long-horned beetle, black rails, among others. The lower Bear also continues to support remnant and/or “stray” wild and/or hatchery-sustained salmon, and in the past it supported both steelhead and sturgeon as well. (Foothills Water Network, 2014).

4.4.1.4 Cherokee Canal

Cherokee Canal is a channelized portion of Dry Creek which extends approximately 23 miles southwesterly from central Butte County to the Butte Sink. Other tributaries of Dry Creek and Cherokee Canal include Clear Creek, Gold Run Creek, and Cottonwood Creek, with a combined watershed area of about 94 square miles (DWR 1989). Cherokee Canal provides for irrigation, drainage, and flood protection of agricultural lands, buildings, and homes. Cherokee Canal forms the majority of the northern boundary of the Sutter Basin area and is at the center of highly productive rice cultivation.



Cherokee Canal is a component of the SPFC that diverts excess floodwater originating in the foothills northeast of Thermalito Afterbay. The facilities consist of levees along Cherokee Canal, the lower reaches of Cottonwood Creek and Gold Run Creek, and irrigation and drainage structures from Butte Basin to high ground. The facilities reduce flood risk to adjacent communities, agricultural lands, area transportation facilities, and irrigation canals. The facilities are maintained by DWR Maintenance Area 13.

The need for channelization and levee construction along Dry Creek originated with the operation of the old Cherokee Hydraulic Mine between 1854 and 1916, during which time approximately 51 million cubic yards of sediment were washed down from the mine's location in Sawmill Ravine to be deposited downstream in a plume which extended for miles downstream (USACE, 1999). The old Cherokee Debris Dam was constructed under permit by the California Debris Commission, now USACE, in 1900 just upstream of where Highway 149 crosses Dry Creek to capture the mining debris, thus halting the sedimentation of Dry Creek. Mining debris accumulated to a depth in excess of 15 feet behind the dam before the structure failed in 1916 (USACE, 1990). Since the failure of the dam, sediment has continued to collect in the downstream reaches of Dry Creek, including reaches that later became the channelized Cherokee Canal.

Original Design Deficiencies:

The Cherokee Canal was designed and built in its current location by the USACE in 1960 under the authorization of the Flood Control Act of 1944. Flows in Cherokee Canal reached or exceeded flood stage on numerous occasions between 1961 and 1968. In 1968 local landowners notified the Central Valley Flood Protection Board and USACE that sediment accumulation was adversely affecting the flood carrying capacity of the canal. Subsequent investigations by DWR determined that the canal could safely pass the design flows with the prescribed three feet of freeboard in all reaches except for the two mile section between the Western Canal crossing and the Richvale Highway Bridge (Highway 162) (DWR 2009).

The Cherokee Canal was designed and constructed with the intent to convey both floodwaters and sediment through the system, but has not performed as intended, as sediment accumulation has been a persistent problem. DWR has excavated approximately 525,000 cubic yards of sediment in four separate projects between 1988 and 1996.

A recent study (ESA PWA, 2011) of the most critical section of the canal between Cottonwood Creek and the Union Pacific Railroad Bridge south of Richland evaluated both the original design and current capacity. The design capacity in this reach is 11,500 cfs, assuming a Manning's n value of 0.03. Results show that:

- The channel can only convey 9,570 cfs while maintaining at least three feet of freeboard.
- The channel can convey the design flow of 11,500 cfs; with a freeboard of less than three feet throughout the reach.
- The maximum capacity of the project reach, at which overtopping of the levees begins to occur, for the as-designed condition is 17,050 cfs.

The original design assumed a channel roughness of a Manning's n value of 0.30, assuming the channel would be maintained in a bare earth condition. This was probably low, even for bare

earth, and subsequent regulatory constraints have resulted in significantly higher channel roughness. (ESA PWA, 2011).

Capacity:

The design capacities of the various reaches of the canal, listed from upstream to downstream, are summarized in the table below.

Reach	River Miles		Design Capacity ¹ (cfs)
	From	To	
Dry Creek to Gold Run at Nelson Rd	21.72	20.22	8,100
Gold Run at Nelson Rd to Cottonwood Creek at Western Canal	20.22	15.82	8,500
Cottonwood Creek at Western Canal to RD 833 Canal Entrance at Afton Rd	15.82	7.92	11,500
RD 833 Canal Entrance at Afton Rd to Lower Butte Basin	7.92	0	12,500

Source: Flood Control System Status Report, DWR, December 2011

¹ From 1957 Revised profile drawings

History of Failures:

Major floods have occurred along Cherokee Canal in 1964, 1986, and 1997, with numerous reports of water at the levee crown. In 1986, the Cottonwood Creek levees broke at its confluence with Cherokee Canal. The right bank breach was approximately 20 feet to 30 feet wide and the breach caused ponding in the area northeast of the Cottonwood/Cherokee confluence. The left bank also failed in 1986 into the Richvale-Butte Canal. The canal contained the breach and flooding did not occur southward. Following the 1986 event, another breach occurred along the left bank of Cherokee Canal just upstream of Nelson Shippee Road Bridge. Property owners reported flood damage in the 1997 flood (FRFMP Stakeholder Meeting Notes, February 25, 2014).

Erosion: USACE has deemed that the south Cherokee canal, left bank, has critical erosion, bank caving, slope stability, and burrowing animal control issues. USACE has also identified encroachments throughout Cherokee canal levees which are likely to prevent performance in the next high water event.

Sedimentation: Investigations by DWR concluded that the section between the Western Canal and the Richvale Highway Bridge is most impacted by sedimentation and as a result is constricted enough to not safely allow the flows to pass the channel design flow capacity of 11,500 cfs. URS prepared a study for USACE that indicates Dry Creek is the major source of sediment in the Cherokee Canal (URS, 2002). Past studies show that a 2-year storm event delivers approximately 23,000 tons of sediment to the canal and a 100-year storm event delivers approximately 103,000 tons. The addition of this sediment to the Cherokee Canal between the Cottonwood Creek junction and Highway 162 bridge has reduced this section’s original design hydraulic capacity by 30 to 40 percent (URS, 2003).

Vegetation and wildlife habitat: The Cherokee Canal and the adjacent Dry Creek watershed are considered by resources agencies to be important wildlife corridors that connect the Sacramento River to the foothills of the Sierra Nevada. Volunteer riparian vegetation grows quickly in the channel. The combination of mineral soil, suitable topography, fresh sediment, and inflows of water from rainfalls and agricultural return has created ideal conditions for germination and growth of riparian vegetation. Typical riparian species within the canal are cottonwoods, willows, and alders, making it difficult and expensive to maintain channel capacity.

Bridge Crossings:

Numerous bridge crossings pose additional hurdles for potential channel modifications. From upstream to downstream, the main bridge crossings include:

1. Nelson Road Bridge
2. Nelson-Shippee Road Bridge
3. Richvale Road Bridge
4. UPRR Bridge
5. Highway 162 Bridge

During high water events, floating debris builds up at the bridge crossings, particularly at the UPRR bridge which, according to DWR maintenance staff, acts like a ‘debris net’ during floods. The right bank levee near the Richvale Road bridge crossing is too low. This section of levee protects major infrastructure including portions of the small community of Richvale, highly valued agriculture processing and storage facilities, wastewater treatment facilities, local public water supply wells, and a local fertilizer plant. Local interests have expressed the concern that if overtopping of the canal were to occur, it would likely occur here first and thus result in the flooding of the only major infrastructure in the area.

Maintenance: Sediment deposition is a major maintenance concern for much of the length of Cherokee Canal, due to the continued discharge of sediment from gravel pits and the Cherokee Hydraulic Mine on Dry Creek and Gold Run Creek. DWR has been removing large quantities of sediment accumulation from the canal as part of its ongoing maintenance activities and is continuing to refine its maintenance practices in order to restore and maintain channel capacity while retaining the wildlife habitat values of the channel. However, DWR’s periodic removal of sediment has become extremely difficult and expensive to carry out due permitting constraints, including mitigation requirements for GGS, work-window restrictions, and the cost of trucking excavated sediment to disposal sites.

In 2009, in its most recent effort to initiate a major sediment removal project in Cherokee Canal DWR prepared and published the Proposed *Mitigated Negative Declaration and Draft Initial Study for the Cherokee Canal Corridor Management Strategy (CMS) Pilot Project: Phase I Sediment Removal*. This study assessed the existing channel habitat and geomorphology and evaluated the potential environmental effects of a proposed CMS Pilot Project. The study proposed to remove approximately 750,000 cubic yards of accumulated sediment in the Cherokee Canal for the four mile section between the Cottonwood Creek confluence and the UPRR Bridge. The project has subsequently been on hold, most likely due to the anticipated high costs of the project and a decision to review Cherokee Canal management options in the context of the CVFPP update process.

4.4.1.5 Sutter Bypass, including Wadsworth Canal

The Sutter Bypass was constructed to create a bypass flood channel for the Sacramento River system as a component of the State Plan of Flood Control. The Sutter Bypass conveys overflow flood waters in a southeasterly direction away from the Sacramento River at a capacity substantially greater than the Sacramento River. As such, it is an integral part of the existing integrated flood management system, which helps protect the small agricultural legacy communities of Colusa, Meridian, Grimes, Robins, Kirkville, and Knights Landing. The Sutter Bypass originates southwest of the Sutter Buttes, downstream of Butte Slough, and terminates at Fremont Weir, 35 miles downstream.

It receives flood flows from the Butte Basin overflow area near Ord, from Moulton Weir, Colusa Weir, Tisdale Weir, Butte Creek, Cherokee Canal, local drainage from the western portion of the Sutter Buttes, local drainage from the eastern portion of the Sutter Buttes via Wadsworth Canal, and local drainage from the Sutter Basin via pump stations.

The Sutter Bypass is a wide flat channel dropping less than 30 feet over a distance of over 35 miles and varying in width from approximately 4,000 feet in its upper reaches to 6,200 feet along its furthest downstream reach between Nelson and Sacramento sloughs where the bypass parallels the Feather River channel.

The West Borrow and East Borrow canals were excavated parallel to the bypass levees to supply the borrow materials needed to construct the bypass channel levees. Both canals convey water year round. Small weirs with fish bypass facilities control the water levels in the canals to facilitate irrigation of the agricultural lands within the bypass.

While primarily a flood conveyance facility, the Sutter Bypass provides multiple benefits to the region and the State, including highly productive agriculture, fish passage and floodplain foraging habitat, and a rich mosaic of wildlife habitats, including agricultural lands, the Sutter National Wildlife Refuge, wetlands, and riparian forest.

Capacity: USACE design flows for the Sutter Bypass increase in the downstream direction, from 150,000 cfs at its upstream starting point at Butte Slough near State Route 20 to the Wadsworth Canal, to 155,000 cfs between the Wadsworth Canal and the Tisdale Weir. Further downstream the Sutter Bypass was designed to pass 180,000 cfs between Tisdale Weir and Nelson Slough and then 380,000 between Nelson Slough and the confluence with the Sacramento River at Verona.

Erosion: The levees of the Sutter Bypass are subject to erosion, primarily from wind waves generated during high water events. A spring 2012 inspection report of the Sutter Bypass east levee noted approximately 370 feet of mid-slope levee erosion located at Levee Mile 11 (DWR 2012). USACE has rated the Sutter Bypass east bank levee as unacceptable and inactive under PL-84-99, in part due to erosion and bank caving (USACE, 2014).

Sedimentation and Vegetation: Given its importance in conveying massive flood flows for the Sacramento River Flood Control Project while protecting adjacent agricultural lands and communities, a significant concern is the incremental loss of channel capacity over time due to sediment accumulation and the growth of woody vegetation in portions of the bypass, including the Sutter National Wildlife Refuge. While sediment is occasionally removed by DWR from the bypass channels of Moulton Weir, Colusa Weir, and Tisdale Weir, the Sutter Bypass itself may be losing depth and capacity over time due to sediment (see Figure 4-16).

Maintenance: Sutter bypass east levee has critical maintenance issues with encroachments, animal control, and discharge pipes/culverts (USACE Periodic Inspection). Wadsworth also has critical maintenance issues with erosion, encroachments, and animal control.

Wildlife Habitat:

The 20-mile long Sutter Bypass provides important fisheries and wildlife habitat. The two borrow ditches along the east and west levees of the Bypass are important links in the migration routes of salmonids and steelhead. The ditches are lined with high-quality riparian habitat, including SRA. Much of the bypass is in rice production, which provides valuable resting, feeding, and foraging habitat for wintering waterfowl, shorebirds, and raptors. Other crops include tomatoes, dry-farmed annual crops, and some orchards.

The Bypass includes two wildlife refuges:

The 2,600 acre Sutter National Wildlife Refuge consists primarily of wetlands, with some riparian and grassland habitats. The refuge typically supports 175,000 ducks and 50,000 geese. The refuge is located within the Sutter Bypass southeast of Meridian.

The Sutter Bypass Wildlife Area is managed by California Department of Fish and Wildlife for fishing, hunting, and wildlife viewing. It consists of the Tisdale Bypass channel and two long, narrow parcels on either side of the Sutter Bypass, for a total of 3,204 acres.

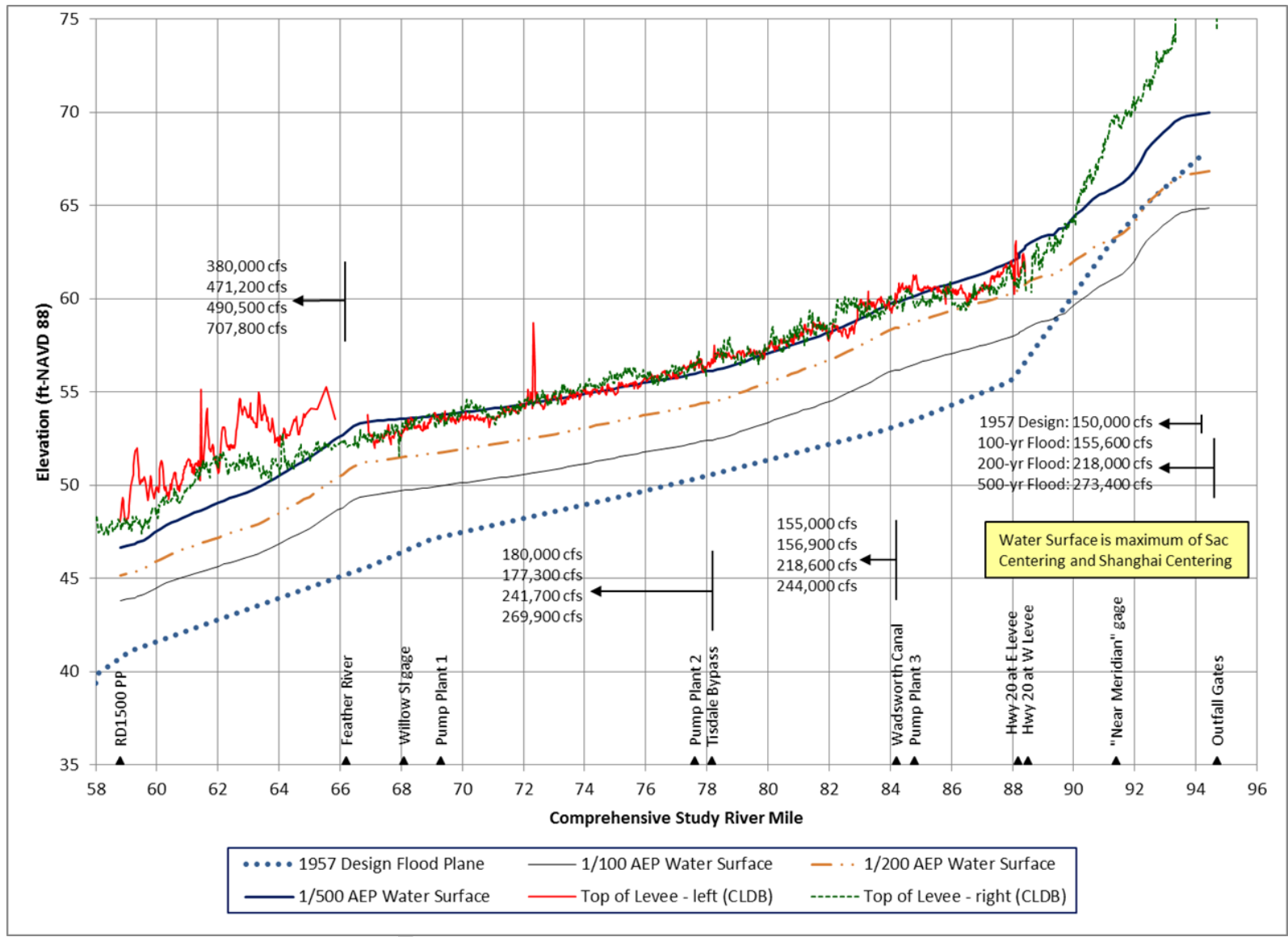


Figure 4-16. Maximum Water Surface Profiles Sutter Bypass

4.4.1.6 Natomas Cross Canal and East Side Canal

Capacity: The 5-mile Natomas Cross Canal has a USACE design capacity of 22,000 cfs. Local drainage from the foothills and plains east of RD 1001 and Natomas, which would otherwise collect in these leveed basins, is intercepted and collected in a system of levees that funnel it to the Sacramento River at Verona via the Natomas Cross Canal.

Erosion: The Natomas Cross Canal rarely experiences significant flow velocities, due to backwater effects of the Sacramento River, the Feather River, and the Sutter Bypass during major flood events. However, during such high water events strong winds can induce significant wave action which has damaged the Natomas Cross Canal levees during major flood events. The north levee is particularly vulnerable to such damage due to wind fetch and typical southerly winds during major storms as was experienced in 1997 and 2006 (personal communication, Tom Engler 3-29-14).

Sedimentation: RD 1001 does not believe sedimentation has caused significant effects on channel capacity in the Natomas Cross Canal, but channel deposits should be closely monitored and removed if aggradation occurs (personal communication, Tom Engler, 3-29-14).

Vegetation: The Natomas Cross Canal has strips of dense riparian vegetation along its length. DWR periodically removes vegetation to maintain channel capacity. Although vegetation has an effect, stages in the canal are largely controlled by the backwater effect of the Sacramento River and Fremont Weir during major floods. Additionally, large woody vegetation along the channel may provide protection against wave wash as areas that lack vegetation experience more severe damage during wind wave events.

Maintenance: The 4.8-mile East Side Canal and right bank levee intercept drainage east of RD 1001 and convey it southward to the inlet to the Natomas Cross Canal. The 4.3-mile Pleasant Grove Creek Canal and left-bank levee similarly intercept drainage east of Natomas and convey it northward to the inlet to the Natomas Cross Canal. The Natomas Cross Canal is confined by RD 1001 levees on the north and RD 1000 levees on the south. During such high water events wave wash can seriously impact levee integrity, particularly on the RD 1001 right bank levee.

4.4.1.7 Fremont Weir and the Yolo Bypass

Fremont Weir and the Yolo Bypass lie within the North Delta\Lower Sacramento River Regional Planning Area, and thus lie outside of the Feather River Regional Planning Area. These facilities currently convey about 80 percent of the flood flows from the Sacramento River system to the Delta, and thus play a critically important role in the overall performance of the SPFC for the Sacramento Valley. The Feather River Region partner agencies are aware that the ND\LS plan formulation effort includes the consideration of improving fish and wildlife habitat, fish passage, and flood conveyance capacity of Yolo Bypass and Fremont Weir. Because any expansion of Fremont Weir and the Yolo Bypass conveyance capacity would have beneficial effects on flood stages in the lower Sutter Bypass and the Lower Feather River, the Feather River RFMP partnering agencies will be supportive of such improvements if the ND\LS region recommends them and local impact concerns are addressed.

4.4.2 Estimated Flood Risk: Expected Annual Damage (EAD) Under Current Conditions and Future No-Project Conditions

As described at the beginning of this chapter, flood risk takes into account the frequency of runoff extremes of various durations, the effects of reservoir flood control operations, the conveyance capacity of flood channels, the fragility of the levees that contain the flood flows, the amount of damageable property at risk, the chance of inundation of that property, and the anticipated damage that would occur in the event of flooding. The estimated risk of flooding, which takes all of these factors into account, can be expressed in terms of expected annual damages. Expected annual damages can be described as the cost of episodes of flooding if those costs were averaged over many years.

Table 4-3 and Table 4-4 prepared in support of the CVFPP (DWR, 2011), provide an estimate of the replacement values of structures and their contents in the region, which total about \$7.8 billion. This does not include the effect of flooding agricultural lands, with the resultant damage to crops, agricultural infrastructure, and productive capacity and regional economic impacts from loss of a major regional economic driver. Nevertheless, it provides a basis for interpreting the expected annual damages, as displayed in Table 4-5. The expected annual damage totals \$68.6 million, which represents about 0.9 percent of the replacement value of structures in the region and their contents.

Table 4-3. Building Replacement Costs in 2010 October \$1,000 – Feather River Basin

Damage Area	Description	Commercial (\$)	Industrial (\$)	Public (\$)	Residential (\$)	Total (\$)
SAC 18	Upper Honcut	1,302	55	0	11,908	13,265
SAC 20	Gridley	51,396	12,784	546	188,162	252,889
SAC 21	Sutter Buttes East	9,172	32,208	11,964	137,974	191,318
SAC 22	Live Oak	11,916	4,882	23,333	188,644	228,775
SAC 23	Lower Honcut	104	3,319	2,432	41,692	47,546
SAC 24	Levee District No.1	8,011	2,286	21,322	162,809	194,429
SAC 25	Yuba City	384,626	89,143	108,676	2,062,691	2,645,136
SAC 26	Marysville	58,704	18,512	32,344	280,785	390,345
SAC 27	Linda-Olivehurst	88,435	21,974	15,834	670,612	796,855
SAC 28	RD 784	2,460	344	5,128	312,281	320,214
SAC 29	Best Slough	161	36	924	13,005	14,126
SAC 30	RD 1001	1,037	1,387	13,072	28,272	43,768
Grand Total		617,324	186,930	235,575	4,098,835	5,138,666

Notes:

Structure Depreciated Replacement Values are in 2010 \$1,000

RD = Reclamation District

Table 4-4. Building Contents costs in 2010 October \$1,000 – Feather River Basin

Damage Area	Description	Commercial (\$)	Industrial (\$)	Public (\$)	Residential (\$)	Total (\$)
SAC 18	Upper Honcut	1,240	17	0	5,954	7,211
SAC 20	Gridley	46,918	7,526	510	94,081	149,035
SAC 21	Sutter Buttes East	6,422	11,927	4,617	68,987	91,953
SAC 22	Live Oak	6,847	4,176	7,497	94,322	112,842
SAC 23	Lower Honcut	69	5,778	798	20,846	27,491
SAC 24	Levee District No.1	4,320	1,962	7,866	81,405	95,553
SAC 25	Yuba City	201,399	94,602	36,449	1,031,345	1,363,795
SAC 26	Marysville	37,883	22,315	12,189	140,392	212,780
SAC 27	Linda-Olivehurst	41,889	17,991	7,485	334,969	402,334
SAC 28	RD 784	1,649	494	1,735	156,141	160,019
SAC 29	Best Slough	70	45	542	6,503	7,159
SAC 30	RD 1001	543	1,013	4,710	14,136	20,401
Grand Total		349,249	167,846	84,398	2,049,081	2,650,573

Notes:

Structure Depreciated Replacement Values are in 2010 \$1,000

RD = Reclamation District

Table 4-5. HEC-FDA Expected Annual Damages for Feather River Basin in 2010 October \$1,000 – No Project

Damage Area	Description	Structure and Contents (\$)	Crop (\$)	Business Loss (\$)	Total (\$)
SAC18	Upper Honcut	23	60	0	83
SAC20	Gridley	407	17	9	433
SAC21	Sutter Buttes East	500	495	45	1,040
SAC22	Live Oak	780	7	39	827
SAC23	Lower Honcut	162	147	58	367
SAC24	Levee District No.1	496	460	113	1,069
SAC25	Yuba City	47,862	123	10,959	58,944
SAC26	Marysville	281	0	84	365
SAC27	Linda-Olivehurst	1,611	18	451	2,080
SAC28	RD 784	721	76	22	818
SAC29	Best Slough	388	323	29	740
SAC30	RD 1001	217	1,538	34	1,789
Grand Total		53,448	3,264	11,843	68,555

Key:
 HEC-FDA = Hydrologic Engineering Center Flood Damage Analysis

5 Solution Strategies and Management Actions

5.1 Planning Context: Central Valley Flood Protection Plan, State System-wide Investment Approach

The 2012 Central Valley Flood Protection Plan recommends a State System-wide Investment Approach (SSIA), which includes a combination of major physical and operational elements which will most cost effectively achieve its goals and objectives. The regional solution strategies and management actions described in this chapter are consistent with the types of actions included in the SSIA. They include improvements to the structures and operations of levees, channels, reservoirs, fisheries and wildlife habitat (especially associated with productive agricultural lands), generally described at a greater level of specificity and detail than provided in the CVFPP.

The CVFPP includes system-wide and regional improvements as summarized in Table 3-2 of the 2012 CVFPP. Of the physical and operational elements described in that table, the following subset could directly or indirectly affect the Feather River region flood management:

- New Bypass Construction and Existing Bypass Expansion
 - Sutter Bypass expansion
 - Yolo Bypass expansion
 - Sacramento Bypass Expansion
- FCO and FBO
 - Oroville Reservoir
 - New Bullards Bar Reservoir
- Flood Structure Improvements
 - Butte Basin small weir structures
 - Upgrade and modification of Colusa and Tisdale weirs
 - Sacramento Weir widening and automation
 - New Spillway at New Bullards Bar Dam
 - Fremont Weir widening and improvement
 - Other pumping plants and small weirs
 - Sacramento system sediment remediation downstream from weirs
- Urban Improvements
 - Target 200-year level of protection for selected projects in the urban and urbanizing areas, protected by the SPFC, developed by local agencies, State, federal partners
- Small Communities Improvements
 - Target 100-year level of protection for small communities protected by the SPFC
- Rural Agricultural Improvements

- Site-specific rural-agricultural improvements based on levee inspections and other identified critical levee integrity needs
- Ecosystem Restoration
 - Fish passage improvements for the Sutter Bypass and fish passage east of Butte Basin
 - Fish passage improvements for Fremont Weir, Yolo Bypass
 - Fish passage improvements for Yuba River and Deer Creek
 - Ecosystem restoration and enhancement for areas within new or expanded bypasses, contributing to or incorporated with flood risk reduction projects
 - River meandering and other ecosystem restoration activities at selected levee setback locations in the Sacramento River Basin

Local stakeholders have expressed an interest in working with the State to further enhance fish passage improvements; the agricultural landowners could assist in working toward this goal by collaborating with local agencies on a voluntary basis to erect fish screens on irrigation ditches to protect salmonids travelling upstream from entering irrigation ditches from main irrigation canals.

The 2012 CVFPP also includes the study of a Feather River Bypass, including an intake structure, for potential inclusion in future updates to the Plan.¹ A potential alignment for such a bypass could follow the existing Cherokee Canal, with an intake for Feather River flood flows in the vicinity of Thermalito Afterbay.

The physical and operational elements discussed in this regional Plan do not include new system-wide improvements to the flood conveyance system capacity described in the SSIA, such as new bypass construction, existing bypass expansion, and the flood structures needed to facilitate their operation. Consistent with the input provided to the CVFPPB during the CVFPP adoption process, the region remains concerned about the potential loss of agricultural lands and resultant economic impacts (Hamilton and O'Brien, 2013), redirected hydraulic impacts, and public expense associated with the implementation of the Sutter Bypass expansion and the creation of a new Feather River Bypass. Additional studies may be needed prior to the final decision. While the Feather River Bypass does have the potential to reduce the flood risk of the urban communities in our region, the impacts and costs do not appear to justify further consideration of this alternative. If the Basinwide Study is going to evaluate measures to reduce the flood risk beyond the 200 year level that will be accomplished by the urban levee improvements currently underway, consideration should also be given to evaluating new or expanded reservoirs as alternatives to the Feather River Bypass and widening of the Sutter Bypass to achieve the goals of providing resiliency, adaptability to climate change and integrated water management.

The regional plan elements described in this Plan are focused on urban and urbanizing area improvements, small community improvements, rural agricultural improvements, and ecosystem

¹ These features were included in the Plan as drafted by DWR, but set aside for further study by the CVFPPB during its adoption of the final 2012 Plan.

restoration improvements that will achieve regional objectives in a way that will be consistent with DWR and the CVFPB's probable system-wide improvements.

The types of system improvements are described in general terms in the following sections. Specific actions are described in chapter 6, 7, 8 and 9. It is the intent of the Plan that these specific actions be combined during implementation as multi-objective projects which achieve the primary goal of improving flood risk management and advance the supporting goals as well. The actions are described separately in this Plan because it is premature to define fully integrated projects prior to the formulation of detailed project design features, identification of funding sources (including incentives and constraints), and development of implementation plans.

5.2 Levees

Levees can be improved in their reliability and rated level of protection in a number of ways. Experience with the regional flood management system suggests that the following management actions can address the range of concerns described in the previous chapter.

Raise crown elevation: Increasing the height of the levee system provides additional freeboard, or elevation difference between the water surface and the levee crown. Overtopping of levees often results in catastrophic failure due to the erosive effect of the overtopping flow.

Increase levee cross section and improve its geometry: Even with poor levee materials such as sand and clay, a sufficiently wide levee with mild slopes can function well, as its sheer mass provides gravitational resistance to uplift, the mild slopes minimize the risk of structural failures, and the long seepage paths reduce the risk of piping. Incremental improvements in levee geometry that result in greater width and milder slopes are helpful, but may need to be augmented with controlled seepage layers to prevent pressure from building up in the levee.

Provide stability berms buttress the levees: Levees that may be prone to slumping through rotational failure can be stabilized through the construction of a buttress berm at the landside levee toe. In a rotational failure the levee embankment fails along a curved surface such that the top of the slope slides downward along the face, while the base rotates upward. This leaves the upper part of the levee with a diminished cross section and a near vertical face along the failure surface. Such rotational failure can be eliminated by putting additional weight on the toe zone, preventing it from moving upward. This in turn stabilizes the upper zone as well. Stability berms are particularly useful for clayey embankments which, when saturated, gain a great deal of weight while simultaneously losing shear strength.

Provide waterside berms and erosion protection on the water side: Where levees are subject to the erosive effects of river currents and wave wash, erosion protection by various means will improve levee reliability. Management actions include planting appropriate native erosion-resistant vegetation such as willow, placing rip-rap layers or berms on the water side, or using combinations of vegetation, soil, and rip-rap to create a highly erosion resistant, but habitat friendly, layer along the stream bank. Erosion can also be addressed using biotechnical techniques such as brush boxes, brush mattresses, and large woody debris, or through levee setbacks as described below.

Provide cutoff walls, seepage berms, or relief wells: These management actions can be used to control the effects of seepage through the levee or under the levee through its foundation. Cutoff walls can be constructed of a variety of materials, including bentonite clay slurry mixed with sand and silt or Portland cement mixed with clay, sand, and silt. Currently, cutoff walls can be

constructed as deep as about 85 feet with long-stick excavators and to about 130 feet with deep soil mixing (DSM) technology (Miriam E. Smith Dissertation, URN etd-07112005-165338). Seepage berms can be constructed on the land side of levees to help counteract the uplift pressure of seepage in the foundation, to slow the rate of seepage, or to intercept it safely without loss of embankment materials. Interceptor or relief wells simply relieve the hydraulic pressure under and near the levee by providing safe pathways for the seepage water to flow to the surface. Filter media and stainless steel screens in the wells prevent the movement of foundation materials as the internal seepage pressure is relieved.

Reconstruct deficient levees in place or construct levee setbacks: With a limited footprint available, reconstruction in place with competent materials under current engineering practices can greatly improve levee reliability. While it is expensive to rebuild a levee in place with new materials, it may offer a solution where other options prove difficult to implement.

Constructing a setback levee in its stead can provide additional channel storage and conveyance capacity, reduces the risk of levee overtopping and erosion failures, benefit habitats, and create recreational opportunities. However, a setback levee will fundamentally alter the potential uses of the land which transitions from levee-protected to floodplain. Given the potential local and regional impacts of such levee setbacks upon established land use, this approach is only recommended where supported by affected landowners, LMAs, and where consistent with county land use plans.

Levee setbacks can be difficult and expensive undertakings, due to the need for large quantities of materials and the impacts on land use and agriculture in the vicinity.

As an intermediate alternative between rebuilding a levee in place and constructing a new setback levee, buttressing the landside of an existing levee will increase levee integrity and allow for increasing the freeboard when needed.

Provide improved access and visibility to facilitate inspection and flood fighting activities: This includes improved all-weather patrol roads, additional access ramps, inspection roads at the base as well as the crown of the levee, and an appropriate vegetation management plan that provides for pruning or thinning of vegetation to provide adequate access while preserving habitat benefits and adhering to O&M requirements.

Remove or improve levee penetrations: Pipes for irrigation and drainage are the primary levee penetrations of concern. They may be difficult to access and inspect, and like all structures, deteriorate over time. Such penetrations can become points of failure by providing preferred seepage pathways or levee voids where floodwaters can erode the levee. Levee reliability can be enhanced by removing or relocating such pipes. To the extent feasible such pipes should be relocated above the design flood elevation, typically 100-year flood elevation.

Provide overflow protection: Levee system resilience can be enhanced in areas where channel capacity and levee freeboard may be exceeded by providing protection to prevent levee failure if design capacity is exceeded and levees are overtopped. Such overflow protection may be provided by the placement of erosion resistant mats, vegetation, or construction of splash cap by placing rocks on the land side of the levee, such that overflow does not erode the levee section.

Provide root barriers: While the risks associated with tree roots are not well quantified at this time, root barriers of sufficient depth may address this concern where warranted. Although steel sheet piles have been available for a long time, less expensive approaches to creating a complete

root barrier are now under consideration. Such barriers could potentially be included with cutoff walls as they are installed.

Incorporate habitat restoration in levee repair or new section: Native grasses can be planted over levee repairs or new levee sections. Native grasses are deeply rooted, perennial plants which may reduce long-term maintenance costs and provide raptor foraging habitat. For example, between 2008 and 2010 SAFCA incorporated native grass establishment over approximately 18 miles of new setback levees as part of the Natomas Levee Improvement Program, pioneering soil conditioning, seeding, and establishment techniques appropriate for levee slopes.

Most of the levee improvement actions described above have been employed in the region to improve levee reliability and level of protection. The selection of the appropriate combination of actions is dependent upon the specific field conditions to be addressed, the project objectives, and available funding.

5.3 Floodplain Transitory Storage

The concept of floodplain transitory storage essentially involves breaching, removing, or setting back levees to allow inundation of previously protected lands. In this region, which has suffered major flood damage due to levee failures over the past 160 years, this concept is a source of concern and is opposed by many residents, property owners, and organizations such as the Yuba Sutter Farm Bureau, due to the potential for loss of productive agricultural land, potential heightened risk for adjacent property owners, and related concerns. Nevertheless, the expansion of the active floodplain through controlled inundation of designated farm land can attenuate peak flows by providing temporary storage of flood waters, thereby relieving pressure on levees. It can also provide multiple secondary benefits such as transitory fisheries habitat, groundwater recharge, improved water quality, and other benefits. Given the concerns about floodplain transitory storage in this region, any specific proposal to implement the concept should only be considered where supported by affected landowners and is consistent with local land use plans, with appropriate compensation for loss of agricultural productivity and land values.

5.4 Channels

Erosion protection: Although the Sacramento River Bank Protection Project has, since its authorization in 1960, provided the authority and mechanism for placing the majority of rock revetment along SPFC facilities, including the main channels of the Feather, Yuba, and Bear rivers, it is unlikely that this program will continue to be available at previous levels of funding and authority. The program has been funded through USACE and DWR, with 75 percent and 25 percent cost-shares, respectively. A total of 915,000 lineal feet (173 miles) of bank protection, have been authorized over the life of the project, including the most recent authorization of 80,000 lineal feet in 2007. The remaining authority to perform additional work is currently less than 100,000 lineal feet. State and local projects will likely need to fill the gap. As described in the previous section, there are various approaches available. Given the concerns of permitting agencies about the cumulative impacts of traditional rip-rap erosion protection on fish and wildlife resources, multi-objective erosion protection projects which incorporate habitat enhancements in the design and operation of new erosion protection are likely to be more implementable and cost effective in the long run.

Channel grading and sediment removal: As described in Chapter 2, one important legacy of the hydraulic gold mining era is that the channels of the Feather River, Yuba River, and Bear River

were choked with gravel, sand, and silt. A portion of this material has been transported downstream through stream erosion, restoring the main river channels to near their original pre-mining profiles. However, huge volumes of hydraulic mining debris remain in these channels as terrace deposits and dredge spoil piles. Removal and grading of portions of this material can improve flood conveyance capacity while concurrently improving fish and wildlife habitat. Any such action must be designed with a full understanding of the fluvial processes and evolving fish and habitat values in order to provide long-term flood risk reduction and habitat restoration benefits.

Channel Dredging: Channel dredging is distinguished from channel grading and sediment removal as described above by the fact that dredging involves excavating sediment from the bottom of an active flowing stream channel. Dredging of river channels has been undertaken to improve channel capacity for navigation, flood conveyance capacity, and other purposes in many locations throughout California, the nation, and the world. In the Central Valley system the most significant dredging projects undertaken include the Sacramento River Minor Project, which resulted in dredging of about 300 million cubic yards of material from the lower Sacramento River near Rio Vista, dredging of numerous new channels in the Sacramento-San Joaquin Delta by local RDs, and the construction of the Stockton Deep Water Ship Channel and the Sacramento Deep Water Ship Channel by USACE. Dredging continues in San Francisco Bay to enhance navigation and commerce, but its use upstream in the Central Valley stream system has been greatly reduced due to regulatory constraints.

As with channel grading and sediment removal, the utility of dredging in any particular portion of the river system is affected by the flow and sediment regime, and any such action must be designed with a full understanding of the fluvial processes and evolving fish and habitat values in order to provide long-term flood risk reduction and habitat restoration benefits.

Because dredging involves excavation in a body of water, key concerns center on the mobilization of toxic materials in sediment such as mercury, increases in turbidity, and direct impacts of large machinery operating within river channels. Resources agencies are particularly concerned about the resultant impacts on listed aquatic species, including migrating and resident fish. It is very difficult to obtain environmental clearances for channel dredging due to concerns about its environmental impacts. For this reason channel dredging is unlikely to play a significant role in multi-objective channel improvement projects in the region.

Channel vegetation management: Improved collaboration among maintaining and regulatory agencies, combined with flood corridor planning, offers the opportunity to optimize the channel benefits of flood conveyance and habitat, while reducing long-term maintenance costs. The need for clearing, thinning, and management of accumulated vegetation in the floodways is necessary and important element of effective flood management in the region. The Feather River Corridor Management Project is an example of this evolving multi-objective approach.

5.5 Reservoirs

Numerous reservoirs have been constructed on the rivers and streams tributary to the Lower Feather River System. They serve a multitude of purposes, including flood control, water supply, power, recreation, fisheries and wildlife habitat, water quality management, and hydraulic mining debris retention. There are four on the Bear River system, including Camp Far West Reservoir, which is the largest and furthest downstream. There are 20 on the Yuba River, including New Bullards Bar Reservoir on the North Fork Yuba River, which is the largest and

most important for flood control, power, and water supply purposes. Daguerre Point Dam, constructed to retain hydraulic mining debris is the furthest downstream. Englebright Dam, which is about 24 miles upstream of the mouth, was constructed primarily to retain hydraulic mining debris, but also provides power, recreational, and wildlife habitat benefits. There are 18 dams on the Feather River system, including the Oroville-Thermalito complex which is the largest in the region.

These 42 reservoirs are an important part of the landscape of the Feather River region and have a profound effect on public safety, environmental quality, and economic health in the region. While major new reservoir construction is highly unlikely, there are opportunities to improve the facilities and their management and optimize their public benefits. Specific options include improved flood management response and water supply management through Forecast-Coordinated Operations (F-CO) and Forecast-Based Operation (F-BO), new or enlarged outlet facilities for existing structures such as the proposed new outlet structure for New Bullards Bar Dam, improved multi-objective management plans, such as the Lower Yuba River Accord approved in 2008, habitat and recreational enhancements in and around the lakes and reservoirs in the region, temperature and water quality monitoring, and control of invasive species.

Given the primary goal of this plan, the focus of reservoir management options will be on F-BO, F-CO, and structural improvements. However, as these are implemented the region will explore opportunities to incorporate multi-objective features as well:

Forecast-Coordinated Operations (F-CO): This involves careful coordination of releases from different reservoirs to reduce downstream flood peaks, thus improving the overall system reliability.

Forecast-Based Operations (F-BO): involves relying more heavily on hydrologic forecasts as the art and science of forecasting becomes more reliable, which could lead to greater reservoir releases prior to a big storm than allowed under current operational criteria, and encroaching on flood storage space to save water if forecasts anticipate minimal runoff for the forecast period.

F-CO has been incorporated into the operations of Lake Oroville and New Bullards Bar Dam and modifications to reservoir operations manuals are currently being contemplated to accommodate F-BO.

Structural Improvements: There may also be opportunities to cost-share with State and federal agencies to upgrade facilities, including gates, spillways, and power plants to improve reliability, efficiency, and performance.

5.6 Fisheries and Wildlife Habitat

Consistent with the supporting goals of the CVFPP and this plan, the region is committed to promoting ecosystem functions and multi-benefit projects. Regional stakeholders, including public agencies, NGOs, and interested individuals have collaborated with State and federal agencies to plan and execute many improvements. Notable among them are securing wild river status for the South Yuba River, constructing major levee setbacks on the Feather River and Bear River, completion of the Lower Yuba River Accord, establishment of extensive conservation easements on land in the region, and improved vegetation and wildlife habitat management in the river corridors. The region has also participated in broad based multi-objective planning efforts such as the Lower Feather River Corridor Management Plan, now in draft form. The Regional Permitting Program process now getting underway offers new opportunities to facilitate the long-

term viability of agriculture in the region, improved wildlife habitat, corridor maintenance efficiency, and streamlined permitting.

The RFMP considers all opportunities to improve ecosystem benefits, as feasible, to improve overall quality of habitat for all species in the region with the ultimate goal being increased habitat in the region and improved ecosystem function. Chapter 6 describes conceptual and specific opportunities for accomplishing these goals in the context of improving flood risk management.

5.7 Operations and Maintenance Constraints

Existing laws set relatively short time limits for some environmental permits given that flood management systems require effective management in perpetuity. With better science, cooperation, and management experience there may be opportunities to modify these laws in a way that the desired protection is achieved more efficiently.

Increased partnering and leveraging of multiple funding sources will expand the opportunities for implementing multi-benefit projects.

Refining work windows that meet the needs for species protection and flood activities, both of which can be very constrained by seasonal events and conditions, will support integrated management of the flood system. Improving habitat in ways that reduce, or at least do not substantially increase, needs for maintenance of flood facilities will be important.

Programmatic permits are needed to allow routine maintenance activities without the burden of piecemeal mitigation, and to facilitate sustainable local financing of LMAs. The Regional Permitting Program process now getting underway may provide the means for formulating and securing programmatic permits for LMA maintenance activities. State Maintenance Areas may be run more efficiently (on the west bank) by local levee districts as opposed to the State.

The concept of consolidating LMAs to achieve administrative and operational efficiencies may be considered as an option to improve system O&M while controlling costs. However, consolidation of historically independent districts, with varying legal descriptions and authorities can be a difficult and complex undertaking. Any future consolidation effort should be based on local interest and support, a detailed understanding of the complexities involved, open communication with affected property owners and residents.

6 Integration of Flood Management with Agricultural Land Preservation, Habitat Enhancement and Restoration

The local flood management agencies within the Feather River Basin believe strongly that flood management and protection of our residents, farms, and communities is the primary focus of this Plan. A secondary but important goal is integrating agricultural land preservation, habitat enhancement, and restoration opportunities where feasible. This chapter describes the attributes of an integrated approach to flood management as envisioned for the Feather River Region. The sections below discuss the compatibility of agricultural cultivation and flood risk management, present strategies for preserving agricultural lands along the flood corridor in ways that are wildlife-friendly, provide a survey of habitat enhancement and restoration opportunities, and explore environmental compliance and mitigation solutions.

6.1 Integrated Approach to Flood Management

The CVFPP is intended to provide an integrated approach to flood system improvement that incorporates ecological stewardship and agricultural protection. The flood risk managers of the Feather River region have embraced this philosophy and recognize that agriculture is an essential component of ecological stewardship. The Regional Partners believe that the agricultural heritage of the Feather River region should be preserved and enhanced while improving flood safety and adding fish and wildlife benefits for the entire region.

The philosophy of keeping land in production agriculture and incorporating agricultural lands in the flood system (including lands in and around the floodway and bypasses) provides floodplain capacity, habitat, and open space, while maintaining the economic viability of the region. Agricultural operations that are managed in ways compatible with nearby flood risk management infrastructure and operations ensure the safety of surrounding farms and communities, and maintaining agricultural operations also limits dense residential development in flood-prone areas. Agriculture has long been recognized as a wise use of the floodplain, thus the economic sustainability of agricultural land use benefits both flood management and environmental goals of the CVFPP.

Flood managers in the Central Valley have successfully integrated environmental and agricultural enhancement and protection into flood management systems, and these successes can be built on in the Feather River region. For example, the Bear and Feather River levee setbacks provide multiple benefits, including risk reduction for surrounding agricultural land, habitat enhancement, and improved flood protection for the region. Another example is the flood bypass system in the Sacramento Valley (which includes the Sutter and Yolo Bypasses), that utilizes agriculture to manage fish and wildlife habitats while providing flood-flow conveyance. Most importantly, the resource stewardship and land management know-how of farmers are valuable, but under-used resources.

Successful implementation of multi-objective flood risk reduction projects may require innovative approaches. For example, the Regional Partners can support agriculture by

developing program incentives in consultation with resources agencies to compensate landowners for ecosystem goods and services provided by private lands, and “safe harbor” agreements between landowners and fish and wildlife agencies can encourage restoration on private lands and allow management of endangered species habitat by landowners. Further investments in research on ways to improve the wildlife benefits of agricultural lands is supported as part of the RFMP. Improved management techniques, applied in cooperation with willing landowners and regional Regional Conservation District offices, may lead to significant new benefits to wildlife species in the region. Additionally, there should be recognition and financial credit/cost-sharing given to projects that incorporate agricultural preservation measures. The Regional Partners also support the continuation of private land ownership within the floodway for habitat, agricultural, and other lands, with a goal of public and private partnerships.

6.2 Preservation of Agricultural Lands and Promotion of Agricultural and Environmental Stewardship

The principle of promoting environmental and agricultural stewardship requires that the broad benefits provided by the natural environment and agriculture be recognized and considered when improving the flood management system. Agricultural lands form the most abundant habitat in the Feather River region for a number of sensitive species, including foraging habitat of raptor species and sandhill cranes (*Grus canadensis*), and the successes in the Yolo and Sutter Bypasses show that agriculture and flood management need not be mutually exclusive endeavors as long as the crop types are compatible with the flood regime.

This Plan acknowledges the habitat value of current agricultural lands for certain species and calls for preservation of these lands to the extent possible as the floodway is modified and/or expanded. The Regional Partners intend to work with DWR CVFPB, and FEMA to ensure rural communities and landowners maintain the ability to build structures necessary for continued agricultural operations within the floodplain, without prohibitive restrictions and requirements on construction or burdensome flood insurance rates. However, utilization of agricultural lands as habitat by threatened and endangered species varies by crop type and agricultural lands do not always meet the full life-cycle habitat needs of some threatened and endangered species. Thus, habitat restoration must also be an integral part of the RFMP. In planning habitat restoration actions, the Regional Partners plan to work with the federal and state resource agencies to develop projects that maximize the benefits of existing, but currently underutilized, habitat in the floodway, with the goal of ensuring minimum conversion of agricultural land. Opportunities for habitat enhancement and restoration are discussed in Section 6.3.

Likewise, it may not be possible to allow all agricultural land to remain in production as the flood risk management infrastructure is improved and/or expanded into neighboring farms. In the cases where the floodway is expanded but the lands within the expanded floodway can no longer sustain farming, the landowners would be made whole, either through direct purchase of the land or by purchasing other farm land for the impacted property owner. Compensation should include consideration for long-term loss of production income, as well as the immediate value of the agricultural land. For example, a walnut orchard removed in its fifth year could have yielded 25 additional years of production to the grower. To offset the resource and economic losses to the local community associated with taking land out of agricultural production, the mitigation measures identified in the CVFPP Consolidated Final Program Environmental Impact Report (California Department of Water Resources 2012) to preserve agricultural productivity and

minimize agricultural land use impacts would be implemented as appropriate. These mitigation measures are:

- Mitigation Measure AG-1a (NTMA): Preserve Agricultural Productivity of Important Farmland to the Extent Feasible.
- Mitigation Measure AG-1b (NTMA): Minimize Impacts on Williamson Act-Contracted Lands, Comply with Government Code Sections 51290-51293, and Coordinate with Landowners and Agricultural Operators.
- Mitigation Measure AG-1c (NTMA): Establish Conservation Easements Where Potentially Significant Agricultural Land Use Impacts Remain after Implementation of Mitigation Measures AG-1a (NTMA) and AG-1b (NTMA).

Some of the strategies described in these mitigation measures include maximizing contiguous parcels of agricultural land during project design, coordinating with growers to develop construction practices to minimize construction-related impairment of agricultural productivity, relocating and/or replacing infrastructure, and making stripped good-quality topsoil from within construction footprints available to less productive agricultural lands. Mitigation Measure AG-1c (NTMA) stipulates that where implementation of mitigation measures AG-1a (NTMA) and AG-1b (NTMA) would not reduce impacts on agricultural land or productivity to a less-than-significant level, conservation easements should be considered. Other options include long-term discounted leaseback arrangements and, as proposed by the Sacramento Area Council of Governments (SACOG) (2012), making agricultural improvements on “potential prime agricultural lands.”

Agricultural conservation easements could be managed according to the wildlife-friendly principles presented below. To the extent practicable, provisions of agricultural conservation easements shall be flexible enough to enable farmers to adapt to changing economic, climate, or other conditions while meeting flood management and environmental goals. Three types of easements are discussed in this Plan: agricultural conservation easements, habitat conservation easements, and flowage easements. Each type of easement, and its purpose, is described below.

- **An agricultural conservation easement** is a voluntary property deed restriction that prohibits practices which would damage or interfere with the agricultural use of the land. The goal of an agricultural conservation easement is to maintain agricultural land in active production by preventing development on the subject lands. Because the easement is a restriction on the deed of the property, the easement remains in effect even if the land changes ownership. As described above, agricultural conservation easements could be purchased from willing farmers to offset impacts upon agricultural land caused by the development of flood system improvements.
- **A habitat conservation easement** is a legal agreement voluntarily entered into by a property owner and a qualified conservation organization such as a land trust or government agency. The easement generally contains permanent restrictions on the use or development of land in order to protect its wildlife or habitat values. The easement restrictions vary greatly depending upon the habitat values of the land, the goals of the conservation organization, and the needs of the landowner. Habitat conservation

easements can be compatible with continued agriculture. Some creative habitat conservation easement ideas have been discussed during stakeholder workshops for the Plan. For example, CDFW is interested in restoring river function (natural sedimentation and erosion processes). If there is an area of farmed land within the floodway that is having issues with erosion, CDFW could work with the landowner to develop a conservation easement that would allow erosion for a certain distance or certain amount of time, which could benefit bank swallow, and that would compensate the landowner for associated crop loss.

- **A flowage easement** grants an entity (for example, the local flood management agency or the State) the right to occasionally inundate land in exchange for payment to the landowner. This could occur on lands where the floodway is widened into adjacent agricultural or other lands. The lands underlying a new levee embankment would likely be purchased in fee title, but if there are lands on the waterside of the new levee that previously were not located within the floodway, and if the landowner is amenable to such an arrangement, a flowage easement could be purchased from the landowner allowing the lands to be flooded during high river flows, and compensating the landowner for any necessary flood-related modifications to the land or operations. This would allow the landowner to preserve ownership of the land and continue farming practices when the land is not inundated.

6.2.1 *Wildlife-Friendly Strategies for Preserving Specific Crop Types*

As stated above, this Plan calls for the preservation of agricultural lands to the greatest extent possible as the floodway is modified and/or expanded. Current farming of several crops offers excellent opportunities to integrate the preservation of agricultural lands with flood risk reduction as well as habitat protection and enhancement. Agricultural lands within the Feather River region include permanent crops such as orchards, low-growing row crops, hay and alfalfa, dry land and irrigated pasture, and rice fields. Each of these crop types can be managed in a way that is compatible with flood risk reduction infrastructure and activities, and each type also offers some degree of habitat value to threatened and endangered species. The habitat value of these crops can be enhanced by certain modifications to agricultural practices, which could be implemented on the lands of willing farmers through incentive programs. This section presents strategies for preserving agricultural lands along the flood corridor in ways that are wildlife-friendly. However, the enhancements to the wildlife value of agricultural land suggested by this Plan will in all cases require the maintenance of agricultural productivity and, private ownership and/or operation.

Wildlife-friendly agricultural practices are for the purposes of this Plan defined as voluntary agricultural practices that are modified to benefit wildlife species. These practices typically reduce yield or otherwise increase cost of farming and therefore, when implemented as part of the Plan, farmers must be compensated for the associated financial losses. Farmers may be compensated by contract or under an easement that prescribes or limits uses of the property or requires particular farming practices for an agreed-upon duration of time, and provides financial compensation for implementation of these practices, or through a landowner incentive program. Examples of wildlife-friendly practices include the flooding of rice fields during the winter to provide wintering waterfowl habitat, or the practice of leaving a small part of a grain crop on the field at harvest to provide forage for waterfowl species.

Local landowners and agricultural organizations involved in the Plan process are supportive of efforts to maximize the species conservation value of production agriculture, but have expressed concern that attracting species covered under the ESA or CESA to their lands would quickly become a liability and jeopardize continued operations. The Regional Partners are sensitive to this issue, and have brought it before the state and federal environmental resource agencies (CDFW, NMFS, and FWS). CDFW and FWS have both developed programs designed to preserve flexibility in agricultural operations, shield landowners from liabilities associated with species conservation efforts, and prevent wildlife depredation. Any voluntary wildlife-friendly farming programs related to the RFMP could be administered in coordination with these programs, which include CDFW's Voluntary Local Program, CDFW's Safe Harbor Agreement Program, CDFW's Private Lands Management Program, CDFW's Shared Habitat Alliance for Recreational Enhancement, or FWS' Safe Harbor Agreement Program. Funding for voluntary wildlife-friendly farming programs could be directed through organizations with existing capacity and understanding of these issues, such as local Resource Conservation Districts (RCDs) and the University of California (UC) Cooperative Extension. Before the details of any wildlife-friendly farming programs are finalized, they will require additional vetting from organizations, like the local RCDs, UC Cooperative Extension, and the Natural Resource Conservation Service, with a broad background in environmental stewardship and agriculture.

DWR, through its Agricultural Lands Stewardship Workgroup, is developing a list of agricultural and land stewardship strategies to promote the development of environmental benefits on agricultural land as a way to protect natural resources while keeping the land in agriculturally productive private ownership. As these strategies are developed and refined, those applicable to the Feather River region can be added to those listed below and incorporated into the implementation of the Plan.

6.2.1.1 Orchards

Orchards, while a vital part of the agricultural economy in the Feather River region, are often one of the less desirable crops to have in or near the floodway from a flood management perspective, as the trees can reduce flood carrying capacity if the flow is in the canopy, attract rodents that burrow holes in levees, and offer little habitat value to threatened and endangered species. Routine pruning of orchard trees discourages the establishment of permanent nests for raptors and other avian species, and expansive tree canopies block view of potential foraging opportunities for raptors species such as the Swainson's hawk (*Buteo swainsoni*).

However, there are already some orchards in the Feather River region that function as part of the floodway. Modeling by hydrologists and water resource engineers would be needed on a case-by-case basis to measure any impacts to the flood management risk reduction system by allowing orchards to remain within the floodway, but the Regional Partners believe that some orchards can be allowed to remain within any new or expanded floodway, as long as the orchard type would remain economically viable under the new flood regime and the grower wishes to continue operations. Rodent control measures would need to be implemented in these orchards to keep burrowers away from the levees. This could be achieved by installing vegetative buffers or moats between the orchards and levees.

Another technique for increasing the habitat value of orchards, while also controlling rodents, is placement of owl and raptor nest boxes and roosts in orchards and pruning to allow light infiltration to the orchard floor. This creates potential foraging opportunities for raptor species,

as has been seen on the Golden Gate Hop Ranch, which uses these techniques to control squirrels and rabbits. Orchard floor light infiltration also has several crop benefits; it encourages fruit and vegetative bud growth and allows the soil to dry out, which enhances the harvestability of nut crops and has been proven to decrease the occurrence of *E. coli* and salmonella.

It could also be possible to manage orchards in a way that makes them more productive as floodplain habitat. For example, farmers could plant a native grassland understory on the floor of the orchard that would breed more insects and food for salmonids when inundated. The goal for such an understory in an orchard would be to plant a species that has limited competition with the tree, is a poor habitat for rodents and other pests while being good habitat for beneficial species, and improves soil quality. However, it should be acknowledged that tree crops are not suited for survival in areas with prolonged periods of inundation.

6.2.1.2 Row and Truck Crops

Row and truck crops have proven potential to be successfully farmed in floodways and bypasses under certain inundation frequency and duration conditions, and they can also provide outstanding habitat for a variety of species when managed to provide foraging habitat. Crops such as corn, millet, milo, safflower, sunflower, and tomatoes are cultivated during the summer months, allowing the land to be fallowed and flooded from fall to spring to provide a valuable source of wildlife forage as well as seasonal wetland habitat. One threatened species in particular that utilizes these types of lands is the Swainson's hawk, for which tomatoes provide foraging opportunities during the summer months. Species such as pheasants, curlews, plovers, mourning doves, ducks, geese, cranes, egrets, shorebirds, and other waterfowl also find forage values in these crop types. Crop rotation and fallowing strategies designed to provide a diversity of wildlife habitat elements should be considered for these lands as a way to fulfill habitat goals of the plan and avoid conversion of agricultural land to habitat elsewhere.

6.2.1.3 Dry Land and Irrigated Pasture

Like row and truck crops, dry land and irrigated pasture are compatible with floodway and bypass uses and can be managed as profitable agricultural ventures that are beneficial to native species. Seasonal cattle grazing on these lands provides benefits to native grasses as the cattle eat nonnative competing grasses and expose emerging native forbs to sunlight, a function that was historically achieved by pronghorn antelope and tule elk. Native wildlife species, such as Swainson's hawk, also utilize dry land and irrigated pasture as foraging habitat. Dry land, irrigated pasture, and annual grassland all provide foraging habitat for Swainson's hawk throughout its breeding season (Estep Environmental Consulting 2009).

6.2.1.4 Rice Fields

Due to their location and soil composition, rice fields tend to be situated on or near historical wetlands in the lower Feather River region. Historic wetlands were the domain of numerous reptile and amphibian species. Today, most of the historical wetlands in the basin have been drained and diked, providing one of the most productive rice growing regions in the nation. Rice crops are routinely flooded to aid in the decomposition of rice stubble, and when flooded, can provide highly valuable habitat for overwintering waterfowl. Rice crops are very common in the Bypass systems of the Central Valley, and when flooded rice fields are connected to fish-bearing streams, they serve as a rich and abundant food source for outmigrating salmonids.

Remnant populations of wetland species still survive in the canals and ditches that surround rice fields in the Feather River region, including the giant garter snake (*Thamnophis gigas*), which is listed by both the State and federal government as a threatened species. The winter management of some rice fields and attendant water control structures located outside of the floodway to ensure rice fields or portions thereof are kept dry and have the necessary features to offer upland habitat during the snake's inactive period would benefit giant garter snake in areas where no nearby dry upland habitat is available during winter. There may be other grading or drainage opportunities that could achieve this objective at lower cost to farmers. Input from rice growers is needed to determine if such practices are feasible and the availability of State, federal, and private funding programs to support these practices should be identified to mitigate costs to growers.

6.2.1.5 Wetland Crop Rotation

The U.S. Fish and Wildlife Service (USFWS) has experienced success with their "Walking Wetlands" program in the Upper Klamath basin of California and Oregon. Under this program, agricultural lands located in former wetland areas are rotated between production agriculture and wetlands. USFWS has implemented the program on both private lands and on refuges. When implemented on private lands, USFWS provides a monetary incentive. Growers participating in the program found that following wetland cycles of one to four years, no soil fumigation was required to return the land to production, saving up to \$200/acre, and yields of some crops increased 25%. In addition, Walking Wetland farmers have discovered that the soil pest and disease control function of wetlands is sufficient to allow for organic crop production (USFWS 2013). Voluntary participation in a Walking Wetlands type of program could be a possibility in the Feather River region if suitable conditions exist.

6.2.1.6 General Agricultural Practices

USFWS, NMFS, and CDFW have expressed support for integrating more wildlife-friendly concepts into farming practices in and near the floodway in the Feather River region. However, there are concerns about the effect of agricultural pesticide use on wildlife and fish species, and about potential pesticide "drift" into adjoining terrestrial and aquatic habitat areas. Pesticide drift can occur via physical movement of pesticides through the air or agricultural tailwater returns (where they can accumulate in shallow-water juvenile salmonid rearing habitat), or through accumulation in insects and other prey species that use both agricultural and habitat areas.

To reduce pesticide risks to fish and wildlife species, operators of lands brought into the floodway or brought under easements or contracts funded by the Regional Partners could voluntarily follow best management practices to minimize pesticide exposure of fish and wildlife species or follow organic farming practices. Monetary incentive programs would be offered to offset the costs associated with these types of BMPs and organic farming, or, for those lands brought under easements, the price of the easements will take into account those costs. Native hedgerows or buffers could be installed to reduce edge effects and filter out potential nutrient and pesticide runoff near sensitive wildlife areas and to protect adjacent farmers from regulatory violations. When planted contiguously, even very thin bands of hedgerows can help with habitat connectivity and provide important wildlife migration corridors. Hedgerows can also be a benefit to agricultural operations by providing year-round food sources for native pollinators.

The Irrigated Lands Program and the Department of Pesticide Regulation currently have similar regulations written into the Annual Restricted Materials Permits (allowed by CalEPA) for farmers near right of ways, wildlife areas, certified organic fields, and waterways.

6.2.2 Summary of Proposed Actions

The following actions provide opportunities for agricultural land preservation and wildlife-friendly agricultural land management that are compatible with flood management:

- Avoid or minimize the loss of agricultural lands to the extent practicable.
- When avoidance is not possible:
 - Compensate landowners directly affected by conversion of agricultural land either through direct purchase of the land or by purchasing other farm land for the impacted property owner. Compensation should include consideration for long-term loss of production income, as well as the immediate value of the agricultural land.
 - Consider mitigating the loss of farmland by making agricultural improvements on “potential prime agricultural lands” identified by local jurisdictions, as is proposed by SACOG in its 2035 Metropolitan Transportation Plan/Sustainable Communities Strategy.
 - Consider mitigating the loss of farmland by purchasing agricultural easements from willing sellers managed according to wildlife-friendly principles to offset any losses of agricultural habitat due to floodway modification/expansion.
- Work with DWR and CVFPB to ensure rural communities and landowners maintain the ability to build structures necessary to continued operations within the floodplain, without prohibitive restrictions and requirements on construction or burdensome flood insurance rates.
- Incorporate relevant strategies from DWR’s Agricultural Land Stewardship Workgroup into Plan implementation.
- Pending favorable hydraulic modeling results, i.e., no changes to stage during critical flows, and no change in near-bank velocities that would negatively influence erosion or sedimentation patterns), allow some orchards, row and truck crops, dry land and irrigated pasture, and rice fields to be placed in the modified/expanded floodways.
- Plant a native grassland understory on the floor of orchards in the floodway that would breed more insect food for salmonids when inundated, if it would not adversely affect farming practices.
- Through landowner funding resources such as State, federal, and private programs, implement crop rotation and fallowing strategies designed to provide a diversity of wildlife habitat elements in truck and row crop lands.
- Livestock grazing on dry and irrigated lands to manage nonnative grass species.
- Utilize flooded rice crops in or connected to the floodway for overwintering waterfowl and juvenile salmonid habitat through cooperative partnerships with landowners, similar to current practices and existing NRCS programs.

- Manage some rice crops outside of the floodway in a dry condition for giant garter snake habitat as long as they contain necessary overwintering habitat features.
- Rotation of crops with wetlands through voluntary participation in USFWS’ Walking Wetlands (if the program is expanded outside of the Klamath Basin) or similar program if suitable conditions exist.
- Offer monetary incentive programs to give growers the option of using best management practices and organic farming practices.
- Offer monetary incentive programs to assist in planting native hedgerows and buffers to provide contiguous wildlife habitat corridors, minimize risk of pesticide drift and accumulation, and provide year-round food sources for native pollinators.
- Promote continuation of private ownership of lands and not exclusively public ownership of habitat and other lands within the floodway with a goal of public and private partnerships.

6.3 Habitat Enhancement and Restoration Opportunities

6.3.1 Conservation Strategy Integration

The identification and implementation of habitat enhancement and restoration activities within the Feather River region will be informed by, contribute to, and be consistent with the 2017 Central Valley Flood System Conservation Strategy (Conservation Strategy). The Conservation Strategy will provide the systemwide context and direction for the DWR’s environmental stewardship activities related to improving integrated flood management in the Central Valley. It will be implemented primarily through multi-benefit projects identified during the development of locally-driven regional flood management plans (including this Plan) and through State-led, basin-wide feasibility studies.

The Conservation Strategy is being developed to address the environmental objectives of the Central Valley Flood Protection Act (California Water Code, Section 9616[a]). These environmental objectives (Table 6-1) provide the overall context for the identification, prioritization, and implementation of habitat enhancement and restoration opportunities within the Feather River Region.

Table 6-1. Environmental Objectives of the Central Valley Flood Protection Act

Objective 1—Promote natural dynamic hydrologic and geomorphic processes.

Objective 2—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.

Objective 3—Promote the recovery and stability of native species populations and overall biotic community diversity.

Source: California Water Code, Section 9616[a]

The long-term vision of the Conservation Strategy is sustainable management of Central Valley floodways that achieves multiple environmental objectives by integrating environmental stewardship into all flood management activities during project planning, design, operation, and maintenance. By improving the Central Valley flood management system through enhancing

environmental stewardship, restoring native riverine and terrestrial habitat, and promoting natural geomorphic and hydrologic processes, flood risks can be reduced and riparian habitats can be substantially increased and improved. This will contribute to the recovery of special-status species and can lessen the need for overall flood system operations and maintenance, reduce environmental impacts, decrease project delays, and reduce regulatory compliance and operating costs. It will also contribute to creating a more flexible, resilient, and sustainable flood management system for the Central Valley.

Consistent with this vision, the Conservation Strategy has four ecological goals (Table 6-2) that will be addressed through habitat enhancement and restoration actions integrated into flood risk reduction projects. To fulfill the ecological goals, the Conservation Strategy focuses on those ecological processes, habitats, and species most closely associated with the flood management system, as well as on the reduction of flood management–related stressors to those targets. The basis and rationale for these target processes, habitats, and species is described more fully within the Conservation Strategy.

Table 6-2. Conservation Strategy Ecological Goals
Goal 1—Ecosystem processes. Improve and enhance naturally dynamic natural hydrologic and geomorphic processes.
Goal 2—Habitats. Increase and improve quantity, diversity, quality, and connectivity of riverine aquatic and floodplain habitats.
Goal 3—Species. Contribute to the recovery and stability of native species populations and overall biotic community diversity.
Goal 4—Stressors. Reduce stressors related to the development and operation of the flood management system that negatively affect important species.
Source: DWR 2013

Multiple existing programs, plans, agreements, and similar efforts are focused on addressing these ecological targets within the Feather River region, and implementation of these programs would positively contribute to the multi-benefit objectives of the Plan. Public agencies have already invested substantially in actions that are consistent with the ecosystem objectives of the Conservation Strategy. In particular, significant setback levees have been constructed in the Feather River region (e.g., the Three River Levee Improvement Authority’s Feather and Bear rivers setback levees and the Star Bend setback levee constructed by LD 1), creating opportunities that can be built upon for habitat restoration and enhancement actions. There are also substantial private investments and private-public partnerships to enhance ecosystems within the region.

Ecosystem enhancement and restoration measures can be incorporated into flood management projects wherever practical, feasible, and appropriate. Specifically, ecosystem restoration and enhancement in the Feather River region would provide the following benefits:

- Increased floodplain inundation compatible with agriculture and native grassland, which creates additional spawning and rearing habitat for native fish species.

- Increased potential for channel migration by locally removing revetment and setting back levees, which provides added potential for regeneration of riparian vegetation.
- Increased extent and continuity of riparian vegetation especially where it will provide the vegetation component of shaded riverine aquatic (SRA) cover, which provides shade (lowering water temperatures), cover, and food inputs for salmonid fish species.
- Improved fish passage at SPFC facilities, which allows salmonid fish species access to a larger area of rearing and spawning habitat.

Objectives for increased marsh habitat, expanding floodplain agriculture, and reducing invasive plants may also be incorporated in flood management actions.

As part of the *Memorandum of Understanding Regarding Feather River Regional Flood Planning and the Environmental Impact Statement/Environmental Impact Report for the Feather River West Levee Project* (Memorandum of Understanding) executed among SBFCA and environmental organizations in March of 2013, SBFCA has agreed to integrate ecosystem enhancement and restoration activities into the Feather River West Levee Project (FRWLP). As part of the MOU, SBFCA has agreed to seek funding for the projects described in sections 6.3.2.1 through 6.3.2.7 below. SBFCA also has agreed to advocate for DWR to provide funding for multi-benefit projects, to pursue changes in the NFIP that would promote agriculture, to consider and work on public access issues, and to coordinate with the signatory environmental organizations on the implementation of the MOU. New public access opportunities should be limited to publicly owned properties with an appropriate buffer zone between agricultural lands, but other arrangements for use of private lands for access could be developed with willing landowners. Public access close to farm land raises issues and concerns which can have significant impacts upon farm operations, including metal theft, farm equipment theft and damage, crop theft and damage, illegal dumping, illegal cultivation of marijuana plants, land squatting by transients, increased chance of pathogens entering the food production chain, and health impacts upon trespassers after spraying of pesticides and herbicides. Recreation resources and potential recreation improvements that could be implemented as part of the Plan are discussed in Chapter 7.

Additional opportunities for ecosystem restoration and enhancement actions could result from cooperation with public agencies, such as the CDFW which manages the Oroville and Feather River wildlife areas in the Feather River region, to develop plans that are of mutual benefit.

Opportunities may also exist to integrate the actions to enhance environmental conditions that are required by the FERC license and MOU for Oroville Reservoir, as described below.

Finally, the Lower Feather River Corridor Management Plan (LFRCMP) will describe a series of potential actions intended to enhance ecological conditions of the Feather River below Yuba City, primarily by revisions to DWR operations and maintenance activities and by habitat restoration activities on lands controlled by CDFW. These various ecosystem enhancement and restoration activities could be integrated into flood risk reduction projects that could provide additional ecosystem benefits, as described below. At the time of release of this report, the Draft LFRCMP highlights and supports many of the same actions identified below. The Feather River Region is supportive of implementing actions identified in the LFRCMP either as individual projects or integrated with flood risk reduction projects to achieve multi-benefit goals of the plans.

6.3.2 Habitat Enhancement Measures

Measures can be incorporated in flood management projects to enhance habitat. Frequently, these measures will also improve flood management. Examples of such measures are summarized below. Many of these are included in the CVFPP Conservation Framework (California Department of Water Resources 2012, Attachment 2).

6.3.2.1 Incorporating Biotechnical Bank Protection along Existing Levees to Reduce River Erosion and Wave Energy

Biotechnical bank protection is the combined use of plants with other materials to stabilize streambanks and levees. This can increase bank resistance to erosion. Vegetation (e.g., tules) can also attenuate wave energy, which reduces erosive forces. Thus, biotechnical bank protection can complement or reduce the need for revetment. Biotechnical bank protection should be incorporated, where appropriate, during design or repair of facilities. It generally entails planting cuttings and container plants in shallow water adjacent to banks, in exposed soil along banks, or in revetment. If incorporated into revetment, some localized modification of revetment (such as incorporating uncompacted soil) may be necessary.

6.3.2.2 Incorporating SRA Vegetation into In-Place Levee Repairs

Waterside plants shading the adjacent water surface is an important component of SRA habitat. Requirements for incorporating these plants are similar to those for biotechnical bank protection, and in some cases incorporated SRA could also provide bank protection benefits.

6.3.2.3 Using Excess Channel Sediment for Levee Material

Where suitable, the use of excess channel sediment for levee material may expand channel capacity and improve riverine habitats, particularly in partially isolated secondary channels, or increase the frequency, duration, and extent of the inundation of lower floodplain surfaces.

6.3.2.4 Applying Levee Design Criteria that Promote Compatibility with Existing and Potential Floodway Habitats

Determination of the design capacity for conveying floodwaters will include riparian vegetation (and associated roughness) in areas throughout the floodway. This allows for future changes in floodway land use and management, increasing the flexibility of the system and potential future environmental benefits.

6.3.2.5 Planting Riparian Vegetation along Channel Banks to Help Prevent Channels Eroding into Levees

A strip of riparian trees can be planted along the water's edge to reduce erosion caused by wind wave fetch or boat wake effects. The vegetation would need to be planted at least 15 feet from the levee toe to be compliant with the USACE's levee-vegetation policy (ETL 1110-2-571), unless a variance can be obtained. The vegetation would form a component of shaded riverine aquatic (SRA) cover, and would reduce water temperature by shading the channel. It would eventually provide instream woody material when branches fall into the channel, and food for fish when insects living on the trees fall into the water. All these attributes would benefit salmonid fish species.

6.3.2.6 Covering Rock Slopes or Rip-Rap Areas with Soil and Planting Native Grassland Species

Rock slopes or rip-rap areas can be covered with soil and planted with native grassland species. Straw wattles and jute erosion control cloth can be used on areas where the soil is expected to be washed away by erosion before the grasses would establish. Levee slopes could be planted with native grass seed using the ridger-roller-seeder, a piece of equipment specifically designed to seed levee slopes with native grasses, developed by the Sacramento Area Flood Control Agency, and successfully used in their Natomas Levee Improvement Program.

6.3.2.7 Disposing of Unusable Degrade Materials into Mounds in the Floodway

Disposition of unusable levee degrade material into floodway mounds could provide areas of animal refugia during high water (only in areas where the hydraulics would not be altered to increase flood risk, and in coordination with the CVFPB and USACE).

6.3.2.8 Controlling the Spread of Invasive Plants

Infestations of invasive plants not only degrade habitat values locally, but can serve as sources of propagules that establish additional infestations (particularly downstream), cause an increase of hydraulic roughness on channel banks and the floodplain, and escalate maintenance costs. Practices to reduce the introduction and spread of invasive species may include preconstruction surveys and mechanical and/or chemical control measures, washing of equipment entering and leaving a site, and restrictions on plant materials used for revegetation (particularly adjacent to river channels). Also, areas dominated by nonnative invasive plants can be revegetated with native plants.

6.3.3 Restoration Opportunities

Multi-objective flood management actions where feasible and appropriate incorporate ecosystem enhancement and restoration actions that are consistent with the goals and objectives of the CVFPP. As mentioned above, SBFCA has agreed to investigate specific habitat restoration actions during the implementation of FRWLP and the development of the RFMP as part of the agreements included in the MOU. Additional ecosystem enhancement or restoration projects for the Feather River region are in the planning stages but have not been implemented.

Rather than attempting to identify new, previously un-described restoration opportunities for the Feather River region, the RFMP recognizes and builds upon the significant prior investment of time and resources that has been expended by various local, State, and non-governmental organizations to develop potential ecosystem restoration and enhancement actions. The integration of these opportunities into multi-objective flood management actions allows leveraging of funding and other resources that will be available because the projects make a contribution to the conservation goals and objectives of the CVFPP and Conservation Strategy.

Specific ecosystem restoration and enhancement actions that could be implemented within the Feather River region are described below, and Table 6-3 summarizes the potential relationship among each action and specific Conservation Strategy ecological objectives for the Feather River region. The ability of these actions to meet multiple Conservation Strategy ecological objectives should be considered because projects that address multiple ecological objectives are more likely to qualify for State cost-sharing under the CVFPP. The location of the restoration opportunities discussed in this section is shown on Figure 6-1.

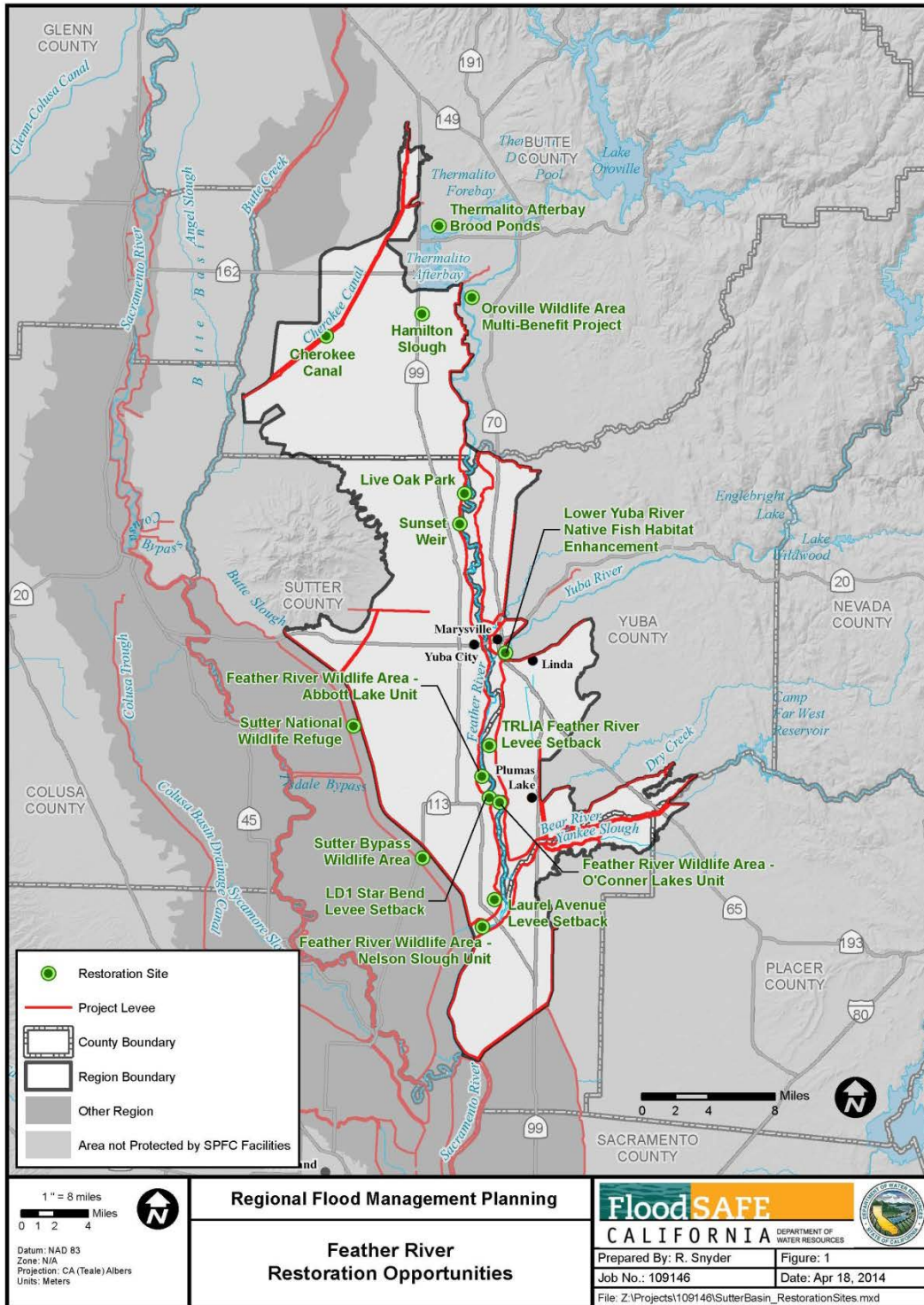


Figure 6-1. Feather River Restoration Opportunities

6.3.3.1 TRLIA Feather River Levee Setback

The Three Rivers Levee Improvement Authority (TRLIA), in collaboration with RD 784 and other State and local agencies, completed construction of the Feather River setback levee in 2009. The new levee created 200-year flood protection for surrounding communities by setting back approximately 4 miles of the existing levee on the left bank of the Feather River opposite Star Bend upstream toward Yuba City. The new levee also created opportunities to restore approximately 1,600 acres of riparian and wetland habitat on former agricultural lands that became part of the Feather River floodway with construction of the setback levee. Conceptual habitat restoration plans have been developed for the area (PWA 2008, River Partners 2009), and DWR's FloodSAFE Environmental Stewardship and Statewide Resources Office (FESSRO) recently awarded approximately \$4.4 million to TRLIA to pay for a portion of the estimated \$9.1 million restoration project.

Implementation of the restoration project would create a mosaic of habitat types including native grassland, riparian woodland and scrub, and freshwater marsh. Because a portion of the setback area was lowered to obtain borrow material for construction of the new levee, opportunities also exist to provide frequently inundated floodplain that would provide important rearing habitat for juvenile salmonids in the Feather River, and riparian vegetation planted along the Feather River would provide additional SRA habitat that would further improve habitat values for salmonids. In addition to habitat restoration, opportunities for implementation of wildlife-friendly agricultural practices also exist in the setback because walnut orchards and other tree crops are cultivated within the southern portion of the setback area. SBFCA is collaborating with TRLIA to mitigate impacts of the ongoing FRWLP in a manner consistent with the CVFPP.

6.3.3.2 Oroville Wildlife Area Multi-Benefit Project

The Oroville Wildlife Area is managed by the CDFW and comprises approximately 11,000 acres west of Oroville that are managed for wildlife habitat and recreational activities. It includes Thermalito Afterbay and surrounding lands along with 5,000 acres adjoining the Feather River. The 5,000-acre area straddles 12 miles of the Feather River, which includes willow and cottonwood-bordered ponds, islands, and channels. The Oroville Wildlife Area is part of the overall Oroville Facilities complex and is therefore affected by the terms of the *Memorandum of Understanding for Licensing of the Oroville Facilities, Federal Energy Regulatory Commission (FERC) Project No. 2100* (FERC Agreement). Much of this portion of the Feather River contains extensive dredger piles, remnants of historical hydraulic mining and the subsequent dredger mining of cobble-sized rock that was deposited in the Feather River floodway.

The FERC Agreement describes numerous multi-benefit habitat restoration actions that are required for this reach of the Feather River. These actions include excavation of the Feather River banks and lowering of adjacent, landside areas to re-connect the river with its disconnected floodplain. The FERC Agreement also requires the excavation of additional side channels that would provide important salmonid spawning habitat and refugia during high-water events as well as the restoration of riparian and wetland habitats to provide habitat for a variety of terrestrial species and shaded riverine aquatic habitat for fish.

One potential project would re-route a portion of the normal discharges from Thermalito Afterbay through a new canal within the Feather River corridor, which would rejoin the river further downstream. The purpose of the bypass would be temperature control; to route cold

water reservoir outflows around the river reach through the Oroville Wildlife Area to facilitate warmer water fish spawning in that reach.”

Removal and beneficial reuse of dredger piles, which are primarily large, cobble-sized, rock, would be required to implement any ecosystem restoration actions within this reach of the Feather River; however, the cost associated with removing this rock has presented a significant challenge for the implementation of ecosystem restoration actions.

SBFCA has proposed a multi-benefit project that improves SWP operations and maintenance, flood system operations and maintenance, energy production via FERC Relicensing Agreement, ecosystem restoration, recreation, and FRWLP environmental mitigation. The project will achieve these multiple goals by improving the riparian ecosystem at the Oroville Wildlife Area so that it can more effectively support the survival of threatened and endangered salmonids and selected bird and plant species. The project’s environmental objective is to increase availability of high-quality habitat on a functional Feather River floodplain (off the main channel) to targeted species by increasing inundation of seasonal habitat relative to the life-cycles of target species, reducing invasive species, enhancing and expanding breeding habitat, and reducing potential fish stranding within the reconnected floodway. Among many benefits, flood system benefits may potentially accrue from flood stage reduction, reliable flood operations resulting from improved hydraulics and increased reliability of inlet and outlet structures, and reduced construction and mitigation costs of FRWLP (increasing funding for other risk reduction measures). SBFCA and NGO’s are currently seeking funding to advance this project, including a recent Prop13 grant proposal.

6.3.3.3 LD1 Star Bend Levee Setback

Levee District 1 (LD 1) constructed an approximately 3,400-ft-long setback levee on the right bank of the Feather River at Star Bend. In addition to providing 200-yr flood protection, construction of the setback area created opportunities for restoration of approximately 45 acres of riparian habitat to benefit terrestrial wildlife and to provide SRA habitat that would enhance fish habitat in the Feather River.

LD 1 has already planted approximately 20 acres of riparian habitat as mitigation for construction of the setback levee. SBFCA recently initiated a project to plant another 20 acres in accord with FRWLP mitigation requirements and CVFPP goals.

6.3.3.4 Feather River Wildlife Area - Abbott Lake Unit

The Feather River Wildlife Area - Abbott Lake Unit is a 439-acre CDFW-managed property located along the right bank of the Feather River upstream from Star Bend approximately seven miles south of Yuba City. The wildlife area is managed to provide riparian habitat for migratory birds and special-status species and public opportunities for wildlife-oriented recreation. Historically, the Abbott Lake Unit supported primarily cottonwood riparian forest, mixed riparian forest, and permanent wetland habitats. Abbott Lake is a permanent lake and its level fluctuates with the level of the Feather River. When the Feather River rises, water backs into Abbott Lake through the lake outlet channel. The lake level is also influenced by underground seepage from the river. Routine habitat management activities that are conducted on the property include chemical and mechanical vegetation management and planting native riparian trees, shrubs, grasses, and forbs. Chemical vegetation management in the floodplain should be

conducted according to best management practices to minimize contamination of aquatic habitats.

A variety of ecosystem restoration actions have been planned for the Abbott Lake Unit (e.g., River Partners 2013). The River Partners project proposes to plant a valley foothill riparian woodland community on 36 acres and three variations of a shrubland community on 98 acres. Native grassland is proposed for 35 acres, making the total size of the restoration 169 acres. In addition, the project proposes habitat enhancement on 270 acres, which will include non-native species removal in areas with established native riparian vegetation. Hydraulic modeling was conducted, demonstrating that the planned vegetation would not increase flood risk to the region and local community.

As part of the FRWLP, SBFCA has conducted preliminary explorations at Abbott Lake to support a multi-benefit project that would potentially provide levee borrow material to support implementation of the FRWLP while lowering the floodplain to provide for more frequent floodplain inundation and additional opportunities for restoration of riparian and wetland habitats.

6.3.3.5 Laurel Avenue Levee Setback

Although no official plans for a setback levee have been proposed, a setback levee along the west side of the Feather River could be constructed from approximately Laurel Avenue extending approximately 2 miles downstream to the Feather River Wildlife Area – Nelson Slough Unit. The Feather River floodway becomes narrower at this point before entering the Sutter Bypass. A multi-benefit project at this location would expand the floodway to increase floodwater conveyance capacity, and it would provide additional opportunities for compatible ecosystem restoration actions, similar to those planned for the TRLIA Feather River levee setback, as well as implementation of wildlife-friendly farming practices. However, further study on the economic impact of taking the associated tree crops in this project are out of production will need to be completed, as tree crops are not suited for survival in areas of prolonged inundation.

SBFCA has previously conducted reconnaissance level study of a setback levee south of Laurel Avenue which would be suitable for the location if there are willing sellers and local support for a multi-benefit, flood risk reduction project that would provide 100-yr flood protection to surrounding rural communities. Various setback options have been suggested, to achieve improved flood conveyance capacity, to provide additional opportunities for ecosystem restoration actions, and to continue wildlife-friendly farming practices. However, preliminary hydraulic evaluations of a range of setback levee options in this area do not demonstrate significant flood risk reduction benefits (Peterson Brustad, 2011, CH2M Hill, 2013). They indicate flood stages may increase in the Sutter Bypass. Most of the acreage within the proposed setback area is currently devoted to orchards which are not compatible with flooding. Any setback crossing Highway 99 would require a major highway causeway to be constructed (Wood Rodgers, 2011). Communications with residents in the area further suggest that there is strong local opposition to a levee setback project in this area, as well as from the Yuba Sutter Farm Bureau. For these reasons the Plan does not include a setback levee in this region, but continued review and analysis of new information regarding potential project features, benefits, and impacts may be warranted. SBFCA and DWR are currently negotiating the scope of a rural risk

reduction project that may include a system-wide improvement that is beyond the capability of current local financing.

6.3.3.6 Feather River Wildlife Area - Nelson Slough Unit

The Feather River Wildlife Area -Nelson Slough Unit is located on the right bank of the Feather River immediately upstream of the Sutter Bypass and is owned and managed by CDFW. The unit occupies a terrace 500–3,800 feet wide between the levee and the low-flow channel along a 3.5-mile reach of the river. State Route 99 bisects the unit via a bridge and causeway. A debris weir occurs where the Feather River empties into the Sutter Bypass. The weir was originally constructed to keep sediment from the Feather River from being deposited into the Sutter Bypass; however, the functionality of the weir has been reduced by the accumulation of roughly 10 feet of sediment on the upstream side. Also, the weir may be adversely affecting the hydraulics and sediment deposition dynamics of the Feather River and threatening the integrity of the levee on the opposite bank of the Feather River by directing the flow of the river into that bank during high flows.

The property is managed to provide riparian habitat for migratory birds and special-status species and public opportunities for wildlife-oriented recreation. The unit is located on previously farmed terraces formed by thick deposits of sandy hydraulic mining debris between the levee and the river. A few low areas, such as sloughs, side channels, remnant borrow pits, and floodplain scour depressions presently support healthy vegetation and provide excellent rearing habitat for juvenile salmonids. Dense riparian canopy is present at the base of the Feather River levee along the sloughs fed by the Feather River. The extent of these habitats is limited at the unit and vegetation does not naturally regenerate or become established in most areas because the terraces are too high and dry and are dominated by dry grassland habitat.

Ecosystem restoration actions for the Nelson Slough Unit would primarily rely on the rehabilitation of the weir and lowering of the floodway to create a variety of flood surface elevations that would support a diversity of habitats, including riparian woodland and scrub, marsh, native grassland, and frequently inundated floodplain while also providing additional flood conveyance through the removal of accumulated sediment. Additionally, side channels could be excavated to provide spawning areas for anadromous fish and to limit fish stranding after flood events. Along with side channels, benches, and shelves could be graded from the floodplain to reconnect the flows or re-engineer the floodplain. Because the Nelson Slough Unit occurs at the junction of the Feather River with the Sutter Bypass, large volumes of sediment are deposited in the area during flood events. Thus, ongoing maintenance of the area would likely be required to maintain the ecosystem functions and services of any habitats that were created within the Nelson Slough Unit.

TRLIA and SBFCA are major stakeholders in the environmental restoration project developed for Nelson Slough through the LFRCMP planning process. Farmers and property owners with a direct interest in the lower Feather River and Sutter Bypass area are also important stakeholders and can provide important, helpful input to the process. Although a definitive restoration plan for the Nelson Slough Unit has not been developed by the LFRCMP, preliminary concept plans have called for the removal of accumulated sediments at the weir and the creation of floodplain benches along the Feather River by lowering the floodplain elevation to create a variety of floodplain surfaces. Grading activities could be incorporated into flood control projects to

provide borrow materials in the region. Planting of appropriate riparian vegetation would occur following grading activities.

6.3.3.7 Purchase of Agricultural Easements

Agricultural easements could be purchased from willing sellers on farmland along the landside of the Feather River levee. Agricultural easements would support ongoing agricultural activities and local communities while limiting urban development within the Feather River floodplain and providing opportunities for the implementation of wildlife-friendly farming practices and targeted habitat restoration actions. Wildlife-friendly farming practices and their potential for implementation within the Feather River region are described in more detail above. Compatible habitat restoration actions could include planting of native plant hedgerows along drainage canals and roadsides, construction or enhancement of ponds and other wetland habitats, and integration of native species, particularly native grasses, into agricultural areas where compatible with normal farming practices. The availability of State, federal, and private funding programs to support these practices should be identified to mitigate costs to growers.

SBFCA recently proposed an agricultural easement program as a public safety strategy to manage long-term public safety risks in the Feather River floodplain. Additionally, agricultural easement programs already exist through Resource Conservation Districts and Land Management agencies in the region. This creates opportunities to leverage non-traditional funding sources to provide benefits for flood control and floodplain management in the region.

6.3.3.8 Cherokee Canal

Cherokee Canal is a channelized portion of Dry Creek that flows southwesterly from central Butte County to the Butte Sink. Other tributaries of Dry Creek and Cherokee Canal include Clear Creek, Gold Run Creek, and Cottonwood Creek. Cherokee Canal is mainly used for irrigation, drainage, and protection of agricultural lands, buildings, and homes. Cherokee Canal forms the majority of the northern boundary of the Sutter Basin area and is at the center of highly productive rice cultivation.

Below Highway 99, Cherokee Canal is constrained within relatively narrow levees, creating a floodway that is subject to flood flows that frequently approach channel capacity. These high-flow events deposit large amounts of sediment that require ongoing maintenance by DWR to maintain channel capacity. Downstream of the Richvale Irrigation District (RID) Canal siphon (located roughly 1 mi downstream of State Highway 162), DWR has completed several sediment removal projects to restore and maintain the channel to design conditions. Upstream of the RID siphon, the capacity of Cherokee Canal has been reduced by 37 to 44 percent. DWR has proposed to remove up to 750,000 cubic yards of sediment up to the Cottonwood Creek confluence, with an undetermined amount of sediment to be removed between Cottonwood Creek and State Highway 99, to restore channel capacity, to improve habitat conditions for a variety of species, including the giant garter snake, and to reduce ongoing channel maintenance needs (AECOM 2009). These actions should be pursued and followed by an evaluation of efficacy before expansion of the Cherokee Canal levees is proposed as a viable project.

In order to address the perpetual sediment loading concern on Cherokee Canal, stakeholders have suggested that upstream sediment basins could be developed to capture the load before it enters the Cherokee Canal and reduce the long-term costs to maintain the conveyance capacity of the canal. These basins could be designed to provide for habitat improvements around the outer

edges of the basin while allowing for peak flow attenuation and a controlled area for sediment removal or mining operations to remove the accumulated debris. These basins could provide a variety of habitat benefits including nesting and foraging habitat for raptors, upland wintering habitat for GGS, and additional wintering habitat for waterfowl. In addition, the ability to trap the sediment load would provide downstream benefit by allowing the restoration of the natural channel condition for fisheries and GGS. The Feather River RFMP is supportive of additional evaluation of upstream detention opportunities that have landowner support.

6.3.3.9 Thermalito Afterbay Brood Ponds

Several brood ponds have been constructed immediately adjacent to Thermalito Afterbay. The brood ponds were created by small dams adjacent to the shore of the lake to impound water in small depressions next to the lake as separate ponds for additional waterfowl habitat. There are two existing ponds north of the Highway 162 Bridge and three additional existing ponds on the south side of the afterbay. The ponds at Thermalito Afterbay range in storage capacity from 3 to 7 acre-feet and were created by dams ranging in length from 328 to 454 feet long. The FERC Agreement requires the installation of additional ponds around the Thermalito Afterbay, and it could be possible to create up to 13 of the 22 ponds identified by the *Thermalito Afterbay Duck Ponds Alternatives* study to further enhance waterfowl habitat in the area. Brood ponds would be designed such that they would not cause stranding of anadromous fish.

6.3.3.10 Hamilton Slough

Hamilton Slough historically flowed from the Feather River during flood flows as a tributary westward from the present day Oroville Wildlife Area to the Butte Sink. Hamilton Slough currently serves as a conveyance channel for irrigation water from Thermalito Afterbay to agricultural lands around Biggs. Prior to the construction of Thermalito Afterbay, flows into Hamilton Slough from the Feather River were regulated by a weir structure immediately downstream of the point where the Thermalito Afterbay discharges into the Feather River. After construction of Thermalito Afterbay, a new water-regulating conveyance structure was built to discharge water into Hamilton Slough directly from the Thermalito Afterbay roughly 1.25 mi downstream of the original weir at the Feather River. Therefore, the original weir is no longer needed and presents an unnecessary encroachment into the Feather River floodway. Along with removing the non-functioning weir and planting riparian vegetation in its place, restoration actions in this area could include planting of additional riparian vegetation along the Feather River and in selected locations within Hamilton Slough to provide additional habitat for terrestrial species and shaded riverine aquatic habitat that would benefit anadromous fish.

6.3.3.11 Live Oak Park

Live Oak Park is located immediately east of the City of Live Oak on the Feather River. Live Oak Park is operated by Sutter County. The park features a boat ramp, campground, and recreational vehicle (RV) park. The park has an approximately quarter-mile-long frontage on the Feather River. Live Oak Park is a well maintained park facility with abundant trees and turf grass. The park is traditional in design. Typical park furnishings such as picnic tables, barbecues, and fire pits are found around the RV park area. The parking lot, RV parking stalls, and main entry road and access are all paved with traditional asphalt paving. A boat ramp splits the riparian forest along the Feather River. Upstream of the boat ramp, the riparian forest is approximately 200 to 250 feet wide. Downstream of the boat ramp, the width of the riparian forest is less than 100 feet.

Restoration actions could include planting riparian vegetation downstream from the boat ramp to create a wider strip of habitat and replacing some or all turf grass and other non-native species with appropriate native plants to increase wildlife habitat values.

6.3.3.12 Feather River Wildlife Area - O'Connor Lakes Unit

The Feather River Wildlife Area -O'Connor Lakes Unit is a 364-acre area managed by CDFW. It is located on the right bank of the Feather River immediately south of Star Bend and approximately ten miles south of Yuba City. The LD 1 setback levee was constructed at the northwestern corner of the O'Connor Lakes Unit.

The O'Connor Lakes Unit is managed to provide riparian habitat for migratory birds and special-status species and public opportunities for wildlife-oriented recreation. Riparian forest is sparse in the northern portion of the O'Connor Lakes Unit but is dense in the southern portion. Cottonwood forest dominates the riverbank. Small ponds are present in the southern portion of the unit. Historically, the riparian habitat located at the northern portion of the unit was overrun by invasive plants. The unit has also contained rootstock and debris from old orchards and some small dunes of borrow pit spoils that are oriented perpendicular to flood flows. The USACE used part of the site as a borrow pit to rebuild portions of the western Feather River levee that were damaged in the 1997 flood. CDFW identified the site as a high priority for riparian restoration because it is located between two tracts of existing riparian habitat and has the potential to create a 2,142-acre block of contiguous habitat.

LD1 used the site as a borrow area for the Star Bend setback levee. The borrow area was used to create a large swale in the center of the unit. In 2010 River Partners completed restoration and enhancement of 228 acres of riparian habitat on the unit (River Partners 2010). Hydraulic modeling by MBK was used to develop a design that would not increase flood risk. The design included flow paths with low hydraulic roughness, where plantings were restricted to herbaceous plants. Habitat for upland game was included in the restoration actions to improve hunting opportunities.

Future habitat enhancement and restoration should build on the habitat improvements that have been made at the O'Connor Lakes Unit. Specifically, areas that were designed for low hydraulic roughness should be maintained to remove trees and shrubs that are not compatible with that objective and that would increase flood risk. Invasive plants such as giant reed (*Arundo donax*) should be removed from restoration areas because they degrade habitat quality and may increase hydraulic roughness. Other opportunities for restoration could include creating new side channels that would provide rearing areas for anadromous fish and refugia during high-flow events.

6.3.3.13 Sutter Bypass Wildlife Area

The Sutter Bypass is a constructed storm water and flood conveyance channel developed in the 1930s and formed by two levees trending south from the Butte Sink, southwest of the Sutter Buttes, and joining the Feather River at Nelson Slough near Highway 99. The Feather River empties into the Sutter Bypass at the Nelson Slough Unit of the Feather River Wildlife area. Upstream of the Feather River, the Bypass conveys water from the Butte Creek watershed (795 square miles) and water that overflows from the Sacramento River via the Tisdale Weir and Tisdale Bypass. In addition to flows from Butte Creek and the Sacramento River, the Sutter Bypass conveys storm water from the Sutter Basin, which flows to the base of the Sutter Bypass

levee and is then pumped into the Sutter Bypass East Borrow Canal at three pumping plants located approximately 3, 12, and 19 miles upstream from Nelson Slough.

CDFW owns and manages the Sutter Bypass Wildlife Area, which is comprised of 3,204 acres of State-owned land, including the Tisdale Weir and Tisdale Bypass as well as narrow strips of land along both Sutter Bypass levees running from approximately Nelson Slough upstream to the State Highway 20 Bridge.

Opportunities to improve aquatic habitat, restore riparian woodland, or create other habitats are limited by the narrow strips of State-owned land that characterize much of the wildlife area. However, selective planting of infill of riparian vegetation within the narrow bands along the edges of the bypass parallel to the direction of flow could occur in locations that currently lack riparian habitat to provide a continuous corridor of habitat along the Sutter Bypass levees, so long as the vegetation does not reduce the conveyance capacity of the bypass and can be maintained so as not to encroach into that capacity in the future. Additionally, there are significant opportunities to encourage wildlife-friendly farming practices within the Sutter Bypass since the majority of the Bypass is privately-owned and actively farmed. Finally, there may be opportunities for fisheries improvements similar to those being evaluated in the Yolo Bypass Salmonid Habitat Restoration and Fish Passage project.

6.3.3.14 Sutter National Wildlife Refuge

The Sutter National Wildlife Refuge is a 2,600-acre preserve with 80 percent of the refuge located within the Sutter Bypass and the remaining portion of the refuge located on the landward side of the east Sutter Bypass levee. Mixed riparian woodlands within the refuge, which are concentrated toward the levees, provide important wildlife habitat. Additional wildlife habitat is provided by an extensive network of seasonal and perennial wetlands that are sustained by water that is diverted to the site and managed similar to an agricultural operation.

Ducks Unlimited and California Waterfowl have completed some improvements to the canal system, but additional improvements to the water supply system would be beneficial. Habitat restoration actions could include targeted treatment of invasive species, particularly Bermuda grass (*Cynodon dactylon*), to improve the habitat values of existing wetlands and the targeted restoration of riparian habitat within narrow bands along the levees that would be oriented parallel to the direction of flow where needed to create a continuous corridor of riparian vegetation throughout the Sutter Bypass and where the planting of riparian vegetation would not adversely affect the Sutter Bypass' ability to convey water during flood events. Such actions should be combined with management of existing vegetation to control and reduce the net hydraulic impacts of the refuge on flood conveyance. Finally, as discussed above, there are extensive opportunities to introduce and encourage wildlife friendly farming practices on private lands within the Sutter Bypass.

6.3.3.15 Lower Yuba River Native Fish Habitat Enhancement

The Lower Yuba River Accord created the River Management Team Planning Group (RMT) to determine if the Accord flow requirements are protective of the fishery habitat. To do so the RMT performs fishery studies on the Lower Yuba River for salmon and Steelhead along with habitat investigations and projects. Actions to benefit Yuba River fish should be coordinated with the RMT, and opportunities may exist to pursue projects to benefit Yuba River fish that would also benefit flood management. The RMT is conducting extensive studies, monitoring and

evaluations that could be of great benefit for the development of ecosystem enhancement and restoration actions on the Yuba River.

6.3.3.16 Sunset Weir

Sunset Weir creates hydraulic head and backwater for the Sunset Pumping Plant on the Feather River near Live Oak. The rock weir forms a significant fish barrier to migrating salmonids and other species. Removal of the barrier is a priority for CDFW and is listed as a FERC Relicensing Agreement project. The FERC proposal includes a new intake and canal directly from Thermalito Afterbay, precluding the necessity for pump station facilities.

6.4 Environmental Compliance and Mitigation Solutions

Implementing construction projects and operation and maintenance activities near river corridors almost inevitably require some level of environmental review and permits because of regulated natural and cultural resources. Regulatory requirements and approvals from multiple agencies may be triggered, including:

- U.S. Fish and Wildlife Service
- National Marine Fisheries Service
- U.S. Army Corps of Engineers
- California Department of Fish and Wildlife
- Federal Energy Regulatory Commission
- State Lands Commission (SLC)
- State Mining and Geology Board
- Central Valley Flood Protection Board
- California Air Quality Control Board (ARB)
- California Regional Water Quality Control Board (CRWQCB)
- California Department of Fish and Wildlife
- California Regional Water Quality Control Board - Central Valley Region
- State Historic Preservation Office (SHPO).

Regulations and permits that may be applicable include:

- Federal Endangered Species Act (ESA), incidental take authorization
- California Endangered Species Act (CESA), incidental take authorization
- CDFW Streambed Alteration Agreement (SAA)
- Clean Water Act, Section 404 Authorization
- Clean Water Act, Section 401 Certification
- Section 106 of the National Historic Preservation Act (NHPA)
- National Environmental Policy Act (NEPA)

- California Environmental Quality Act (CEQA)

Additional agencies with approval authority over a project or other project stakeholders may also have an interest in the environmental compliance process; for example, cooperating agencies under NEPA and responsible agencies under CEQA may provide input on the implementation of the environmental review process, or stakeholders may express concerns with a mitigation approach (e.g., restoration of riparian habitat in a floodway potentially obstructing flows during a high water event). Regional multi-objective projects where multiple overlapping jurisdictions are involved can add another layer of complexity.

Typically, environmental review, permitting, and implementation of mitigation measures are conducted on a project-by-project basis. This approach often provides the easiest “fit” with environmental review and permitting requirements because specific details of project design, and therefore resource impacts, can be developed, and funding for mitigation is provided by those with a direct stake in the project (i.e., the project proponent and any funding partners). However, this project-by-project approach can result in schedule and cost inefficiencies if multiple activities are undertaken in a particular area or by an individual agency or group of entities achieving a common goal or mandate. For example, conducting separate environmental review and permitting for each of a series of seepage berms to be installed over a number of years along the same waterway, but by different agencies, could result in a repeat of similar efforts for each berm that might be avoided through an alternative, comprehensive approach.

A project-by-project approach also ties mitigation activities such as habitat preservation, restoration, or creation to a specific project by time and geography. For example, if part of the mitigation plan for a project is to create wetland habitat, that creation would typically need to be initiated by the project proponent in the same timeframe as when the impacts occur, and it is typically preferred that the creation be located as close as possible to the location of the impact. In addition, project proponents often must take on the obligation of long-term monitoring and management of habitat creation, preservation, and restoration areas that are frequently outside the normal suite of functions undertaken by the project proponent.

Moreover, capital improvement projects are often pitted against long-term operations and maintenance agencies competing for the same mitigation resources, often on the same river; this results in inefficiencies that reduce the efficacy of required mitigation activities.

Many of the challenges presented by project environmental review, permitting, and mitigation, can be reduced or avoided through various regional and/or programmatic environmental permitting options. These may range from a large regional Habitat Conservation Plan (HCP) to provide ESA compliance for a variety of covered activities to a program Environmental Impact Report (EIR) prepared by a single CEQA lead agency to streamline future CEQA compliance for related agency activities.

Although “up front” investment of time and resources is often required to develop programmatic environmental permitting options, this investment could pay future dividends through more rapid, streamlined, and cost effective environmental review and permitting for future projects. Various options for programmatic environmental permitting are described below. Under many of these options, the Regional Partners, or other entities, could work with the regulatory agencies to streamline the permitting and compliance processes for future RFMP projects and simplify authorizations for individual projects.

6.4.1 Feather River Regional Environmental Permitting Program

DWR has initiated the Feather River Regional Environmental Permitting Program to obtain, at a regional and programmatic level, permits for construction and maintenance activities associated with implementation of the CVFPP and the Conservation Strategy in the Feather River region. The goal of the program is to obtain regional permits for compliance with the following laws:

- ESA
- CESA
- Clean Water Act (Sections 401 and 404)
- Section 10 of the Rivers and Harbors Act
- California Fish and Game Code Section 1600
- The Natural Historic Preservation Act Section 106
- NEPA
- CEQA

Regional permits obtained under this program are intended to cover activities such as routine maintenance, structural repairs, reconstruction, improvements to or new levee construction, and multi-beneficial conservation actions such as levee setbacks, and ecosystem restoration and enhancement. The regional permits will be applicable to projects that are implemented by numerous entities, including DWR and local maintaining agencies, on a voluntary basis.

DWR is currently working with local flood management interests to inform them of and request their participation in the development of regional permits, and more broadly with community members to solicit their input on the process. DWR plans to produce a public draft Feather River HCP document and CESA 2081 permit application by 2016. DWR hopes the HCP will provide the necessary framework and content to support development of the other regional permits. DWR anticipates beginning implementation of the Feather River Regional Permitting Program in 2017.

6.4.2 Regional Habitat Conservation Plans

HCPs support compliance with the ESA by providing incidental take authorization for activities covered by the plan (covered activities). An HCP is prepared by an applicant under Section 10 of the ESA and is typically utilized when there is no federal agency associated with the project that would undertake consultation under Section 7 of the ESA. An HCP can be prepared for an individual project or activity where incidental take is expected to occur, or for a number of related activities to be undertaken by one or more applicants, or can cover a broad range of activities within a large geographic area, such as a county.

An HCP may address a single threatened or endangered species, or multiple species, including species that are not currently provided protection under the ESA. Species addressed in the HCP (covered species) may include those that may become listed during the life of the HCP, or that would benefit from conservation activities that could prevent listing. By providing a mitigation framework for the covered species, other environmental review processes, such as CEQA and NEPA, may be expedited as the HCP may be referenced as a sufficient mitigation for impacts to all covered species.

A Regional HCP covering all or a portion of the RFMP area could address flood risk reduction projects, as well as a variety of other potential covered activities such as operation and maintenance of flood risk reduction facilities, operation and maintenance of irrigation canals, construction of new infrastructure projects, and planned urban development. Once in place, a Regional HCP allows streamlined ESA permitting by identifying appropriate conservation sites and compensatory mitigation in the region ahead of implementation of the individual projects included in the covered activities.

Implementation of a Regional HCP would allow a temporal and geographic decoupling of endangered species mitigation and project impacts. Mitigation activities (e.g., habitat restoration and preservation) could occur prior to a project being implemented, and the “credit” is then available for when projects take place. Conversely, project applicants typically participate in an HCP through the payment of fees to mitigate for their project’s impacts, and the fees are collected by an HCP implementing agency that uses the fees within a reasonable amount of time to implement mitigation actions. The project applicant is not obligated to implement any habitat preservation, restoration, or creation activities concurrent with, or prior to project impacts. In addition, any management and monitoring of habitat mitigation sites is conducted by the HCP implementing agency and is not the responsibility of the project applicant.

A Regional HCP for the RFMP area could also be designed to recognize the value of agricultural land to threatened and endangered species. As an example, the San Joaquin County Multi-Species Habitat Conservation and Open Space Plan (SJMSCP) (<http://www.sjcog.org/DocumentCenter/View/5>) identifies the value of certain types of agricultural land to Swainson’s hawk and other covered species. Fees collected from HCP participants are used, in part, to purchase agricultural conservation easements from willing sellers to retain these agricultural habitat values in perpetuity. A Regional HCP for the RFMP area could serve as a mechanism to help preserve the agricultural values of the region and provide financial benefits to individual land owners selling conservation easements.

In addition, multi-benefit projects that provide improved conditions for HCP covered species beyond what would be needed to mitigate their own impacts could potentially incorporate those “net positive benefits” into the HCP for use as mitigation for other projects, and be used as a way to reach habitat goals within the FRRFMP while avoiding loss of valuable agricultural lands.

6.4.3 Natural Community Conservation Plans

The Natural Community Conservation Planning (NCCP) program is an effort by the State of California and numerous private and public partners that takes a broad-based ecosystem approach to planning for the protection and perpetuation of biological diversity. An NCCP is very similar to an HCP in that it provides for the regional or area-wide protection of plants, animals, and their habitats, while allowing compatible and appropriate development. However, where an HCP is species focused, an NCCP more overtly encompasses ecosystem and habitat values. In addition, where an HCP supports compliance with the ESA, an NCCP supports compliance with CESA and focusses on State-listed species. Similar benefits to those described above for an HCP could also be applicable to an NCCP, and joint HCP/NCCP documents can be prepared.

One effort in the region is the Yuba-Sutter NCCP/HCP, which is a cooperative planning effort initiated by Yuba and Sutter counties in connection with improvements to Highways 99 and 70, as well as future development in the area surrounding those highways.

6.4.4 Regional Advance Mitigation Planning

Recognizing the potential value of taking a programmatic approach to mitigating biological resources impacts from infrastructure projects, several State and federal agencies are collaborating to develop Regional Advance Mitigation Planning (RAMP) in California. The RAMP program could provide a model for providing biological resources mitigation for RFMP projects.

RAMP participants include infrastructure agencies (DWR and California Department of Transportation (Caltrans)), and State and federal resource agencies including CDFW, USFWS, NMFS, and the USACE regulatory office. The effort also receives support from The Nature Conservancy (TNC) and Resources Legacy Fund (RLF). These nonprofits have secured several grants from private foundations to support the RAMP effort, as well as helping extensively with science and analysis, outreach, and policy development (see <https://rampcalifornia.water.ca.gov/> and http://www.water.ca.gov/cvfmp/docs/2012CVFPP_Att9A_June.pdf)

RAMP is a more comprehensive approach to mitigating unavoidable biological resource impacts potentially caused by State infrastructure projects, such as roads and levees. This approach allows for natural resources to be protected or restored as compensatory mitigation before infrastructure projects are constructed, often years in advance. The advance time frame allows strategic mitigation to be implemented and made functional before an infrastructure project's unavoidable impacts occur. Mitigating in advance allows for more efficient project approvals, more certainty to cost estimates, and takes advantage of conservation opportunities before important land is lost through land use to conversion.

The FRRWG or another entity could use the RAMP program as a model to develop advance mitigation for RFMP projects that would not already participate in the RAMP, or could collaborate further with the RAMP program to have RAMP mitigation “credits” (if they are developed) potentially available for RFMP activities.

Depending on the types of mitigation activities undertaken under an advance program, such as RAMP, mitigation credits could assist with, and expedite compliance with the ESA, CESA, Clean Water Act, NEPA, and CEQA.

6.4.5 Activity-Specific Programmatic Permitting

In scenarios where a similar activity will be implemented multiple times, developing some type of program-level permitting can be an effective streamlining approach compared to repeating permitting processes each time the activity is undertaken. DWR is testing this approach with the Small Erosion Repair Program (SERP). The SERP is intended to provide a streamlined process for DWR to identify, obtain regulatory authorization for, and construct small levee repairs on levees maintained by DWR within the Sacramento River Flood Control Project (SRFCP) area. Several flood risk reduction features within the RFMP area are included in the SERP project area. (see <http://www.water.ca.gov/floodmgmt/fmo/msb/smallererosionrepairs.cfm#dpeir>)

The SERP uses programmatic authorizations, issued by federal and State agencies that typically have regulatory authority over levee erosion repair projects, to streamline the process for implementing small erosion repairs in accordance with conservation-based design and monitoring standards established in the SERP Manual. Projects that qualify under the SERP are eligible to receive authorization within a shortened time frame because they are designed to minimize effects on fish and wildlife resources, including listed species, and to protect and

enhance the existing aquatic and riparian habitats comprising the riverine corridor. Authorizations streamlined under the SERP consist of Clean Water Act permits from USACE, ESA compliance with USFWS and NMFS, streambed alteration agreements from CDFW, and water quality certification with the CRWQCB.

For activities in the RFMP that are repeated numerous times, such as operations and maintenance or similar new infrastructure elements that are constructed in multiple locations, a programmatic permitting regime similar to the SERP could be beneficial. The FRRWG or another entity could use the SERP program as a model to coordinate with regulatory agencies to develop a process for streamlined approval for qualifying projects or activities.

6.4.6 Master Streambed Alteration Agreement

If the FRRMFP includes similar repeated activities that require a Streambed Alteration Agreement from CDFW (Fish & Game Code section 1600), and obtaining a SAA is not included in a program similar to the SERP, there is an option for obtaining an SAA that would prevent the need to repeatedly apply for and obtain separate agreements for individual projects or activities. A Master SAA (Master Agreement) may be obtained to cover a large, multi-phased project consisting of smaller specific projects for which detailed project plans are not available at the time the SAA is applied for. The SAA process would then be streamlined as each smaller future project is implemented. Master SAAs can have durations longer than the 5-years typical of Standard Agreements.

6.4.7 Program EIR

Section 15168 of the State CEQA Guidelines describes the uses of a program EIR. A program EIR is typically considered when a series of actions that can be characterized as one large project are related either:

- Geographically
- As logical parts in the chain of contemplated actions
- In connection with issuance of rules, regulations, plans, or other general criteria to govern the conduct of a continuing program
- As individual activities carried out under the same authorizing statutory or regulatory authority and having generally similar environmental effects which can be mitigated in similar ways

In addition, when information on future elements of the larger project is not sufficiently developed to support a project level EIR analysis, the future activities may be evaluated at a more general programmatic level using a program EIR.

When subsequent activities considered in the program EIR are ready for implementation, a checklist may be used to determine whether the environmental effects of the activity were covered in the program EIR. If it is found that the subsequent activity has no new effects not already identified in the program EIR, and no new mitigation would be required, the subsequent activity can be approved as being within the scope of the project covered by the program EIR, and no new CEQA document would be required. If there are new effects or new mitigation measures are needed, a CEQA document addressing the subsequent activity may focus solely on the new effects or mitigation that had not been considered before.

If the RFMP includes activities that fit within the uses of a program EIR, devoting the time and resources to the early preparation of such a document could streamline and expedite CEQA review for future activities.

6.4.8 Conservation and Mitigation Banks

A conservation or mitigation bank is a commercial enterprise that enhances and preserves natural resources to create “credits” that can be sold to mitigate for impacts to similar resources elsewhere.

Generally, a conservation bank protects threatened and endangered species habitat. Credits are established for the specific sensitive species that occur on the site. The term “mitigation bank” is generally applied to banks that implement wetland restoration, creation, and enhancement to generate credits for the wetland habitat types on the site.

Conservation and mitigation banks are typically developed and operated by private entities that purchase properties in areas where demand for mitigation credits are anticipated; restore, create, enhance and manage habitat on the property to generate credits; and sell those credits to individuals or entities who require mitigation for impacts to those resources. However, the potential is available for public entities to develop and operate conservation and mitigation banks, or to create public/private partnerships with bank developers. Credits developed by a public entity, or via a public private partnership, could be applied to impacts generated by the public entity, and any excess could be made available to others.

If implementation of the various elements of RFMP is anticipated to have a sufficient cumulative impact on a particular resource, early development of a conservation or mitigation bank addressing that resource could expedite future permitting and potentially reduce overall mitigation costs.

6.4.9 Restoration Project Funding

Long-term monitoring and maintenance of restoration projects are essential to assure that the project goals are achieved and sustained over time. Endowments are an option to assure stable funding for these activities. The goal of such endowments is to assure that they are large enough to fund annual monitoring and maintenance activities, while accumulating enough interest to maintain stable purchasing power despite inflation. Typically this requires that the initial endowments be about 20 times the estimated annual costs, which can represent a significant capital outlay during project execution. The difficulty of creating such endowments may be exacerbated by restrictions on the use of State bond funds, which, depending upon the specific authorizing language, may be unavailable for long-term operation and maintenance purposes.

Table 6-3. Ecosystem Enhancement and Restoration Opportunities and Related Conservation Strategy Objectives										
Project Description	Floodplain Inundation	Riverine Geomorphic Processes	SRA Cover	Riparian Habitat	Marsh Habitat	Floodplain Agriculture	Threatened and Endangered Species	Revetment	Levees	Fish Passage Barriers
TRLIA Feather River Levee Setback ¹	X	X	X	X	X	X	X	X	X	
Oroville Wildlife Area Multi-Benefit Project ¹	X	X	X	X	X		X		X	
LD1 Star Bend Levee Setback ¹	X	X	X	X			X		X	
Feather River Wildlife Area - Abbott Lake Unit ¹		X	X	X	X		X			
Laurel Avenue Levee Setback ¹	X	X	X	X	X	X	X	X	X	
Feather River Wildlife Area - Nelson Slough Unit ¹	X	X	X	X	X		X			
Purchase of Agricultural Easements ¹						X	X			
Cherokee Canal Corridor Management Plan				X	X		X			
Thermalito Afterbay Brood Ponds					X					
Hamilton Slough			X	X			X			

Table 6-3. Ecosystem Enhancement and Restoration Opportunities and Related Conservation Strategy Objectives

Project Description	Floodplain Inundation	Riverine Geomorphic Processes	SRA Cover	Riparian Habitat	Marsh Habitat	Floodplain Agriculture	Threatened and Endangered Species	Revetment	Levees	Fish Passage Barriers
Live Oak Park			X	X			X			
Feather River Wildlife Area – O'Connor Lakes Unit	X	X	X	X	X		X			
Sutter Bypass Wildlife Area				X		X	X			
Lower Yuba River Native Fish Habitat Enhancement		X					X			
Sunset Weir										X

¹ Projects referenced in the *Memorandum of Understanding Regarding Feather River Regional Flood Planning and the Environmental Impact Statement/Environmental Impact Report for the Feather River West Levee Project*

7 Recreation

7.1 Recreation Resources and Opportunities

7.1.1 Plan Approach to Recreation

While flood risk reduction and flood management constitute the paramount goal of this regional Plan, increasing public recreation opportunities is a secondary objective where it can be achieved compatibly with agricultural operations and ecological habitat objectives.

The importance of recreation and river navigation is well established in state and federal laws. The Commerce Clause of the U.S. Constitution conveys on the Federal government “the control for that purpose, and to the extent necessary, of all the navigable waters of the United States...This power to regulate navigation confers upon the United States a dominant servitude, which extends to the entire stream and the stream bed below ordinary high-water mark.” *U.S. v. Rands*, 389 U.S. 121 (1967).

Under California law, the principle of a public right to access navigable waterways runs parallel to the Federal concept of a navigable servitude. Article X, section 4 of the California Constitution guarantees members of the public a right of access to the navigable waters of the state, which are held in trust for the benefit of the people:

“No individual, partnership, or corporation, claiming or possessing the frontage of tidal land of a harbor, bay, inlet, estuary, or other navigable water in this State, shall be permitted to exclude the right of way to such water whenever it is required for any public purpose, nor to destroy or obstruct the free navigation of such water; and the Legislature shall enact such laws as will give the most liberal construction to this provision, so that access to navigable waters of this State shall always be attainable for the people thereof.”

This right is also reiterated in statute (see, e.g. Gov. Code, § 39933). This right is inherent in the public trust under which the navigable waters are held (see *Marks v. Whitney* [1971] 6 Cal.3d 251; 79 Ops.Cal.Atty.Gen. 133, 135-146 [1996]). The interest of the public in the waters and bed of a navigable river is analogous to that of the public in a public road. See, e.g., *People ex rel. Younger v. County of El Dorado*, 96 Cal. App. 3d 403, 157 Cal. Rptr. 815 (3d Dist. 1979).

Although the state may not “divest the people of the State of their rights in navigable waters of the state,” the public’s right to access navigable waterways is not absolute. For example, the public has no right to trespass and cross private lands in order to reach navigable waters to hunt or fish. *Bohn v. Albertson*, 107 Cal. App. 2d 738, 238 P.2d 128 (1st Dist. 1951). The state’s authority to control and regulate usage of its navigable waterways is absolute when it is acting within the terms of the public trust. For example, an agency may restrict the public’s access rights in a specific instance if the purpose of the restriction is to promote the overall use of navigable waters. (*City of Berkeley v. Superior Court*, supra, 26 Cal.3d at 523-526), and when there are competing trust uses, the state may prefer one use over another. (*Carstens v. California Coastal Com.* (1986) 182 Cal.App.3d 277, 289 (holding that the law did not preclude an agency from considering “commerce as well as recreational and environmental needs” in mediating access disputes).

The California State Lands Commission has jurisdiction and management authority over public trust lands below the ordinary high water mark, including land that may be seasonally dry, on the Feather River, Bear River, Jack Slough, and Honcut Creek and these waters and seasonally dry lands are within the public's right for recreation access.

Moreover, beyond the legal principles that support the concepts of recreation and navigation, people are attracted to rivers. The Feather River corridor (hereafter: corridor), including its tributaries, provides great potential as an amenity for area residents, as well as tourists from outside the area, for uses such as fishing, hunting, trail use, boating (motorized and non-motorized), picnicking, camping, traditional Native American uses, and environmental education. Realization of this recreation potential can improve the quality of life for area residents, and tourism can increase the local economy. Public access to the corridor allows a connection to the history of our rivers for commerce, exploration, trade, transportation, and recreation. Therefore, the approach to recreation in this Plan is to identify potential recreation enhancements through measures that could be considered as secondary objectives in pursuing flood management projects toward achieving multiple benefits.

New public access opportunities should be limited to publicly owned properties with an appropriate buffer zone between agricultural lands, but other arrangements for use of private lands for access could be developed with willing landowners.

A critical caveat to facilitation of public access is overcoming illicit public uses, such as trespass, vandalism, graffiti, garbage dumping, homeless camping, depositing garbage and human waste, underage drinking and drug use which leads to illegal and violent behaviors, and unauthorized vehicle use. Public use of the river corridor must be planned, designed, constructed, operated, and maintained in a manner that does not compromise flood management facilities or agricultural infrastructure or operations, and in a manner that would avoid and minimize the potential for these illicit uses. These are not only nuisance concerns for adjacent landowners and farm operators, but can be serious public safety and economic issues. Through provision of safe, designated facilities with sufficient amenities and resources for patrol, operations, and maintenance, positive public use can curb illicit uses.

An additional important aside is that inclusion of recreation enhancements can increase funding opportunities through facilitating eligibility for different funding sources, enticing recreation organizations to become partners in project implementation, and increasing the cost-share through some funding programs.

7.1.2 Recreation Need

In general the Central Valley, of which the Feather River region is a part, has less recreation facilities and access to public open spaces compared to other regions of the state. The land in the Central Valley is privately owned and valuable as farmland and therefore is devoted overwhelmingly to agricultural land use (California State Parks 2007). In 2003 California State Parks began a study to investigate park and recreation needs and resources in the Central Valley. This effort is ongoing and has been called California's Central Valley Vision Plan (California State Parks 2004).

California's Central Valley Vision Plan has a large public outreach component, and throughout this effort, residents have expressed strong interest in river access, including but not limited to fishing access, boat ramps, watercraft docks, near-water trails with interpretive signage and

maps, swimming/beach/water play areas, day use facilities, and nature study areas. Varied recreation opportunities (passive use settings, visitor's centers/museums, multi-use trails and associated facilities, open turf areas for informal play, geocaching, OHV areas with camping and day-use areas, and boat-in camping sites) have also been requested, and residents have high interest in increasing and updating camping facilities. Participants in the Central Valley Vision Plan process have also requested additional state park lands, such as transfers of lands from local governments to the state, riverfront properties that are adjacent to other public lands, riparian habitat areas, and open space such as working farms developed through implementation of the Williamson Act (California State Parks 2007:14-15).

The Feather River region has a park land to population deficit, which means that people travel out of the area to recreate elsewhere because there are little or no local facilities. Part of the reason there is a dearth of recreation facilities is because the region overall used to be more rural and agricultural. As communities in the region grow, there is a need to localize recreational opportunities (Cleveland pers. comm.). According to a letter received by the Regional Partners from River Partners, there is a gap of over 17 miles between the Star Bend boat ramp and Verona boat ramp on the left bank of the Lower Feather River. On the right bank, there is no boat launch access south of Boyd's pump, which, according to River Partners, amounts to a 22-mile gap in meaningful river access. The gaps in access translate to lengthy sheriff and emergency response times, which is a public safety concern. River Partners believes future river access points should be designed in a way that will allow the public to use the river in ways that promote easy access, reasonable entry and pull-out points for non-motorized boats, and access for motorized watercraft within a framework that supports public safety, flood control, and multi-benefit projects (Swagerty pers. comm.).

7.1.3 Recreation Setting

The Feather River and its adjacent levees are a popular recreation venue for local residents and visitors. While recreation opportunities vary among locations along the river, recreationists are attracted to water-based recreation as well as land-based recreation on the levees and facilities surrounding the river. Water-based recreation activities include boating, fishing, kayaking, canoeing, floating, tubing, water skiing, and swimming. Land-based activities include bicycling, walking, hiking, hunting, bird-watching, wildlife viewing, enjoying nature trails, photography, picnicking, and more. Access to the Feather River is provided by state wildlife areas, local parks, and a wildlife sanctuary. Many parts of the shoreline, especially north of Yuba City and Marysville, are inaccessible to recreationists.

Boating is a common activity along the Feather River. Motorized boat use—water skiing, use of personal watercraft, and cruising along the river—is especially popular in various locations. Kayaking and canoeing is occasionally favored in portions of the river. Boat ramps are distributed approximately every 7 miles along the Feather River between Thermalito Afterbay and the Sutter Bypass.

Fishing is another popular recreation activity throughout portions of the corridor. Anglers fish from boats and the shore throughout the reaches of the river.

Yuba City and Marysville are both immediately adjacent to the Feather River within the corridor. Three other communities are within 3 miles of the Feather River levee: Biggs, Gridley, and Live Oak. All five communities have policies or plans involving recreation interfacing with the

Feather River levee and have recreation resources which could be affected by modifications to these levees.

Recreation facilities and resources adjacent to rivers or river levees are grouped by county and described below. See Figure 7-1 for locations of these recreation facilities and resources. Other recreation resources in the Plan area or nearby are also shown in the figure for context, but not described in detail below.

7.1.3.1 Butte County

Oroville Wildlife Area

The Oroville Wildlife Area (OWA) is managed by CDFW. The OWA is 11,869 acres in size and is primarily riparian woodland habitat along the Feather River and Thermalito Afterbay (California Department of Fish and Wildlife 2012a). Hunting, fishing, swimming, picnicking, hiking, horseback riding, birding, biking, boating, camping and other activities are allowed in the OWA (California Department of Fish and Wildlife 1974:2). In addition to these activities, dog training is allowed from July 1 through March 15 in designated areas, and there is an onsite shooting range (California Department of Fish and Wildlife 2012a). The OWA is accessible by vehicle travel, boating, biking, horseback riding, and walking from public roads or trails.

City of Gridley Boat Ramp

The City of Gridley Boat Ramp is managed by the City of Gridley. The boat ramp is next to the City's water treatment plant on the east bank and downstream from the East Gridley Road crossing of the Feather River and provides opportunities for boating and day use (City of Gridley 2010:18).

7.1.3.2 Sutter County

Live Oak Park and Recreation Area

The Live Oak Park and Recreation Area is managed by Sutter County. The campground, RV park, and boat ramp at the facility allow for camping and boating in addition to swimming, picnicking, and day use (City of Live Oak 2010:2). The Live Oak Park and Recreation Area is located at the terminus of Pennington Road on the west bank of the Feather River.

Feather River Wildlife Area

The Feather River Wildlife Area (FRWA) is comprised of eight separate wildlife area management units. Five wildlife area units are located on the west side of the Feather River in Sutter County. These five areas from north to south are: Morse Road Unit, Shanghai Bend Unit, Abbott Lake Unit, O' Connor Lakes Unit, and Nelson Slough Unit. These five units total 1,724 acres (California's Protected Areas Database 2014). Three units are located on the east side of the Feather River in Yuba County and are described below under the Yuba County heading.

All management units in Sutter County are located east of the Feather River levee. Morse Road Unit is a 62-acre management unit located immediately south of the terminus of Morse Road. Shanghai Bend Unit is a 98-acre management unit located adjacent to the Yuba City at the terminus of Shanghai Bend Road. Abbott Lake Unit is a 409-acre management unit located north of the terminus of Star bend road. O'Connor Lake Unit is a 467-acre management unit located south of the terminus of Star Bend Road and north of the terminus of Wilkie Road. Nelson

Slough Unit is a 688-acre management unit located south of Laurel Avenue and north of the Sutter Bypass (California's Protected Areas Database 2014).

The FRWA is accessible by vehicular travel, boating, biking, and walking from public roads or trails. Hunting, fishing, trapping, birdwatching, hiking, nature study, picnicking, and boating are allowed in the FRWA (California Department of Fish and Wildlife 1991:2). Hunting is restricted to certain seasons for authorized species. CDFW has a special hunt at the Nelson Slough Unit every November and plans to continue sponsoring this hunt for the foreseeable future. No permits, passes, or reservations are required to use the wildlife area for other allowed uses. There is a Class I Bike Trail on top of the Feather River Levee in the Shanghai Bend Unit and hunting is not allowed in the Shanghai Bend Unit (California Department of Fish and Wildlife 2012b).

Park and Recreation Facilities within Yuba City

There are five park and recreation facilities in Yuba City that directly interface the Feather River. From north to south these are: Feather River Parkway Bike Trail, Willow Island Park, Veterans Park, Yuba City Boat Ramp, Peach Bowl Little League Fields, and Yuba Sutter Dog Park (City of Yuba City 2004:6-4). The recreation facilities within Yuba City are integrated with the urban fabric and are accessible in numerous ways providing places for fishing, swimming, picnicking, walking, biking, wildlife viewing, boating, baseball, and other activities.

Feather River Parkway Bike Trail

The Feather River Parkway Bike Trail is 5 miles long and runs between Northgate Drive and Shanghai Bend Road on the Feather River west levee. The trail is heavily used (McIntire pers. comm.). The trail will connect to Yuba City's Class I and Class II bike trail network at Northgate Drive, B Street, and Shanghai Bend Road in the future (Feather River Air Quality Management District 1995: 16).

Willow Island Park

Willow Island Park is 172 acres in size and is located immediately north of the Highway 20 bridge. Construction on the first phase of Willow Island Park began in 2012 with several more amenities planned for future phases. The first phase of Willow Island Park includes pedestrian and bicycle trails, a picnic area, and a parking lot. Willow Island Park is expected to be a heavily used park once completed and has been used as a popular skimboarding spot (McIntire pers. comm.).

Veterans Park

Veterans Park is a passive use park with a World War I memorial located adjacent to the Feather River Levee at the west abutment of the 5th Street Bridge. Veterans Park is managed by Yuba City and has minimal use by the public (McIntire pers. comm.).

Yuba City Boat Ramp

Yuba City Boat Ramp is located off of 2nd Street east of downtown Yuba City and immediately upstream from the Feather and Yuba River confluence on the Feather River. Yuba City Boat Ramp has RV campsites, barbecues, picnic tables, showers, bathrooms, boat launching facilities, and a small marina (City of Yuba City 2012). Yuba City Boat Ramp is owned and managed by Sutter County and is heavily used by the public (McIntire pers. comm.).

Peach Bowl Little League Field

Peach Bowl Little League Field comprises three baseball diamonds located adjacent to the Yuba City Boat Ramp and Feather River levee. Peach Bowl Little League Field is managed by Peach Bowl, a nonprofit volunteer little league organization and it does not provide formal river access. The ball diamonds are heavily used (McIntire pers. comm.).

Yuba Sutter Dog Park

Yuba Sutter Dog Park is 5 acres in size and has an off-leash area for dogs, benches, drinking water, and shade trees (Yuba Sutter Dog Park 2012). Yuba Sutter Dog Park is located on land owned by Caltrans and is operated by Off the Leash Dog Park, a nonprofit volunteer group. The dog park is heavily used (McIntire pers. comm.). Yuba Sutter Dog Park is located on the south side of Yuba City abutting the Feather River levee, but does not provide formal river access.

Boyd's Pump Boat Ramp

The Boyd's Pump Boat Ramp, just south of Yuba City, is a public boat launching facility on the Feather River managed by Sutter County. The facility has a parking area and boat ramp that provides an opportunity for motorized and nonmotorized boat launching. This facility is located east off the Garden Highway south of the Oswald Road intersection.

Bobelaine Audubon Sanctuary

The Bobelaine Audubon Sanctuary is a 430-acre wildlife sanctuary owned by the National Audubon Society and managed by volunteers of the Sacramento Audubon Society. Bobelaine is a rare remnant of the riparian forests that once projected 2 to 5 miles on either side of the rivers in the Great Central Valley of California. The sanctuary is registered as a "State Ecological Reserve" and is protected by CDFW and the National Audubon Society. It is also listed as part of an "Important Bird Area" by the National Audubon Society. Hiking, walking, and wildlife viewing are all allowed recreational uses within the preserve (Sacramento Audubon Society 2012). Bobelaine Audubon Sanctuary is most easily accessed from Laurel Avenue on the southern end, but stretches north of Cypress Avenue.

7.1.3.3 Yuba County

Feather River Wildlife Area

The Feather River Wildlife Area (FRWA) is comprised of eight separate wildlife area management units. Three units are located on the east side of the Feather River in Yuba County and from north to south are: Marysville Unit, Star Bend Unit, and Lake of the Woods Unit. These three units total 1,180 acres (California's Protected Areas Database 2014). Five wildlife area units are located on the west side of the Feather River in Sutter County and are described above under the Sutter County heading.

Park and Recreation Facilities within Marysville

There are two park and recreation facilities in Marysville that directly interface with local rivers. River Front Park west of downtown fronts on the Feather River, and Plaza Park east of the Highway 70 Bridge abuts the Yuba River levee on the south side of town (City of Marysville 2014). The recreation facilities within Marysville are integrated with the urban fabric and are accessible in numerous ways providing places for fishing, swimming, picnicking, walking, biking, wildlife viewing, boating, baseball, and other activities.

River Front Park

River Front Park is a 233 acre regional park that contains the majority of the sports fields in Yuba County and is located adjacent to the Feather River in Marysville (Yuba County 2008:13). The park also features a golf driving range, nature area and Mervyn's Pavilion, Lion's Grove picnic area, an OHV MotoCross Course, a BMX track, and a boat ramp (City of Marysville 2014).

Plaza Park

Plaza Park is a 0.6 acre neighborhood park near the Bok Kai Temple at 1st and D Street that features benches and picnic tables (City of Marysville 2014). The park abuts the Yuba River Levee, but does not provide formal river access.

Star Bend Boat Ramp

Star Bend Boat Ramp is a 9.2 acre special use site and one of two public boat ramps on the Feather River in Yuba County off Feather River Boulevard west of the community of Plumas Lake. The facility serves a large geographic area and functions as a regional facility (Yuba County 2008:14).

Feather River Floodway Corridor

Immediately adjacent to the Star Bend Boat Ramp and the Feather River Wildlife Area, the Three Rivers Levee Improvement Authority (TRLIA) plans to implement the TRLIA Feather River Floodway Corridor Restoration Project in the 1,600 acre setback area from the Feather River Setback Levee Project. The project is a multi-benefit project with primary goals of providing economic, flood protection, agricultural, socioeconomic, and ecosystem benefits. A complementary goal of this project is to develop the area as a community asset by providing recreational amenities, including multiuse trails (bike, hiking, and horse trails) and access to the Feather River for fishing, launching canoes, and kayaks (Three Rivers Levee Improvement Authority 2013:1-2).

7.1.4 Recreation Opportunities

7.1.4.1 Conservation Strategy Integration

The identification and implementation of open space and recreational opportunities within the Feather River Region will be informed by, contribute to, and be consistent with the 2017 Central Valley Flood System Conservation Strategy (Conservation Strategy). The Conservation Strategy will provide the systemwide context and direction for DWR's environmental stewardship activities related to improving integrated flood management in the Central Valley. It will be implemented primarily through projects identified during the development of locally-driven regional flood management plans (including this Plan) and through State-led, basin-wide feasibility studies.

The Conservation Strategy is being developed to address the environmental objectives of the Central Valley Flood Protection Act (California Water Code, Section 9616[a]). The long-term vision of the Conservation Strategy will be sustainable management of Central Valley floodways that achieves multiple environmental objectives by integrating environmental stewardship into all flood management activities during project planning, design, operation, and maintenance. The long-term vision identified in the Conservation Strategy supports planning and design of flood

management projects involving recreation and the involvement of recreation advocacy groups in the planning process. The Conservation Strategy identifies several desired project outcomes and the following could be supported by incorporating open space and recreational facilities into the planning and design process:

- Reducing long-term maintenance and management costs.
- Nurturing productive partnerships, both within State agencies and with external groups.
- Promoting local agency and public support for sustainable practices that further the goals and objectives of the Conservation Strategy.
- Promoting development and implementation of projects that provide multiple benefits, including recreation, conservation, agriculture, water supply, and other values.

The CVFPP Conservation Strategy acknowledges that when included as part of project design, ecosystem restoration and recreational benefits can help justify project funding where traditional benefit-cost ratios are low. Several physical improvements can provide open space and recreational benefits in addition to improved flood management, agricultural land preservation, and habitat enhancement. The CVFPP Conservation Strategy identifies several types of projects where increasing recreational opportunities could be explored, including fish passage; levee construction, reconstruction, and improvement; and floodwater storage and reservoir forecasting, operations and coordination. In addition, easements, levee maintenance and repair, setback levees, land- and water-use coordination to reduce peak runoff, and bypass expansion and construction projects could all include open space and recreation enhancement project elements.

Recreation measures can be incorporated into flood management projects wherever practical, feasible, and appropriate. Specifically, open space and recreational facility enhancement in the Feather River Basin would provide the following benefits:

- Support local agencies by helping provide high-quality recreational facilities and access to open space and waterways.
- Assist local agencies in developing and implementing a comprehensive regional recreation multi-use trail system through use of corridors provided by the levee and flood management infrastructure.
- Provide recreation features on levees and in flood management lands safely and efficiently.
- Incorporate recreation features that benefit the safety and stability of levees, flood management infrastructure, and resources.

7.1.4.2 U.S. Army Corps of Engineers Participation

The U.S. Army Corps of Engineers (USACE) has broad authority to include recreation as a project purpose in cost-share projects, as granted by the Flood Control Act of 1944, as amended, the Federal Water Project Recreation Act of 1965 (Public Law 89-72), and the Water Resources Development Act of 1986 (Public Law 99-662). These laws provide a basis for federal participation in the planning, design, and construction of recreation facilities in a wide variety of water resource projects.

Present policy allows USACE participation in cost-shared multi-purpose projects with recreation features as long as there is a non-federal recreation sponsor, the recreation costs are equal to or less than 50% of project costs and the local cost share is 50%. Though the USACE will not participate in acquiring lands for recreation purposes, federal participation in land acquisition is allowed for providing access to public lands, parking, potable water, sanitation, and related developments for public control and for health and safety, and USACE policy allows basic recreation facilities that take advantage of project-created opportunities to be constructed as long as they are on lands acquired for non-recreation purposes. These policies are described in the Corps Engineer Regulation No. 1105-2-100, Planning Guidance Notebook, Appendix E—Civil Works Missions and Evaluation Procedures, Section VII—Recreation (pages E-179 to E-198) and Exhibits E-2 and E-3.

Keeping in mind the USACE mission with respect to recreation articulated in USACE policies, the Feather River Regional Plan represents a unique opportunity for local communities in the vicinity to address flood risk management arising from the many local waterways that flow in and around the region while improving recreational opportunities at these same waterways. The waterways that drain the study area are mostly undervalued and underused in terms of recreation opportunities and can be improved to provide recreation facility projects along and within study area levees and flood control lands to better serve the recreation needs of the communities in the Feather River Region.

7.1.4.3 Additional Opportunities

Additional opportunities for open space and recreational opportunities could result from cooperation with other public agencies, such as CDFW, DWR, State Parks, Chico State University, TRRIA, and USFWS – all own and/or operate lands or facilities in, or close to, the Feather River Basin that provide recreation opportunities.

Opportunities may also exist to integrate the actions to enhance open space and recreational opportunities through cooperation with local agencies and non-governmental organizations. The cities of Biggs, Gridley, Live Oak, Marysville, Sutter County, and Yuba City, and Yuba County all own, operate, or have plans to operate lands or facilities on or adjacent to Feather River levees that provide recreation opportunities. Many of these local agencies have identified goals and objectives to provide more access and opportunities for recreation to new and existing recreational facilities along rivers and flood control lands within the Feather River Region. Some of these plans include interregional bikeways, an integrated accessible pedestrian network, equestrian trails, canoe and boat launches, marinas, camping facilities, picnic areas, water focused civic and urban plaza elements, and adding new park and open space land to meet established thresholds in General Plans. Policies specifically mention river access, river trails, and river recreation as priorities including the City of Gridley General Plan, City of Gridley Bicycle Plan, Sutter County General Plan, Yuba City General Plan, Feather River Parkway Strategic Plan, City of Live Oak General Plan, Marysville General Plan, Yuba County General Plan, and Yuba County Parks Master Plan.

Community groups such as environmental councils and fishing, biking, hunting, and community service clubs may also have interest in supporting recreation opportunities. As described above, the National Audubon Society owns and operates an Audubon sanctuary on and adjacent to the Feather River levee. Peach Bowl, a nonprofit little league organization operates on lands immediately adjacent to the levee. Other groups, such as the Yuba-Sutter Cycling Club or Ducks

Unlimited may not own land on or next to levees, but have strong interest in different aspects of recreation and could be part of a collaborative planning effort.

7.1.5 Recreation Measures

Measures can be incorporated in flood management projects to enhance recreational opportunities. Frequently, these measures may also improve flood management. However, maintenance of recreational facilities cannot be funded with flood protection benefit assessments. The measures listed below are divided into primary measures and supporting measures. Primary measures are those measures that can stand alone, such as construction and/or improvement of hiking trails and trail heads. Supporting measures are those measures that occur in tandem with primary measures or other supporting measures, such as construction and/or improvement of restroom facilities and construction and/or improvement of vendor facilities. Examples of primary measures include:

- Development of multi-use trails along levees and flood management lands as transportation linkages.
- Development of day use areas along levees and flood management lands.
- Development of river access along levees and flood management lands.
- Development of hunting and fishing facilities within levees and flood management lands.
- Development of campgrounds and recreational vehicle (RV) parks at levees and flood management lands.
- Development of a public education or nature center at the levee or on flood management lands.

Examples of supporting measures include:

- Development of hiking trails and trail heads at the levee or on flood management lands placing users in close contact with nature, which can encourage appreciation and stewardship of natural resources.
- Development of Class I bike trails at the levee or on flood management lands for multiple uses and user groups and can facilitate flood management maintenance.
- Development of equestrian trails at the levee or on flood management lands.
- Development of parking areas at the levee or on flood management lands which can be low impact design (LID) and facilitate flood management maintenance.
- Development of restroom facilities at the levee or on flood management lands.
- Development of directional and interpretive signage at the levee or on flood management lands.
- Development of wildlife viewing platforms at the levee or on flood management lands.
- Development of group picnic areas at the levee or on flood management lands.
- Development of play features at the levee or on flood management lands.
- Development of motorized boat ramps at the levee or on flood management lands.

- Development of non-motorized boat put-in and take-out access points.
- Development of designated swim areas at the levee or on flood management lands.
- Development of fishing piers at the levee or on flood management lands.
- Development of vendor facilities at the levee or on flood management lands.
- Development of shooting ranges at the levee or on flood management lands.
- Development of hunting blinds at the levee or on flood management lands.
- Development of RV connections at the levee or on flood management lands.
- Development of a natural and cultural resource center at the levee or on flood management lands.
- Development of a native plant demonstration garden at the levee or on flood management lands.

Detailed descriptions of the primary measures are provided below.

7.1.5.1 Multi-Use Trail

The development of multi-use trails could be part of levee repair projects, new levee projects, development of levee maintenance corridors, or other levee improvement work. They must be designed and managed such that they do not compromise the integrity of the adjacent or underlying flood protection infrastructure. These important transportation links are highly sought after for their recreation and health benefits. Multi-use trails are composed of the following supporting measures: hiking trails, bike trails, equestrian trails, parking areas, restroom facilities, signage, and wildlife viewing platforms. These amenities serve bicyclists, runners, walkers, hikers, equestrians, and wildlife enthusiasts. Depending on the amount and types of traffic anticipated in the multi-use trail corridor, developing separate trails for the different uses may be required.

Many of the potential routes for multi-use trails are immediately adjacent to CDFW and USFWS wildlife areas. Multi-use trails along the levees will allow more visitors access to these spaces; however, the trails will need to be designed so that the habitat and resources the wildlife areas are intended to protect are not compromised.

Multi-use trails should be designed as part of a network or a loop whenever possible to avoid users needing to backtrack. Multi-use trails defined in this study create new connections and will be an important part of the local existing and proposed trail system.

7.1.5.2 Day Use Area

The development of day use areas could be part of levee repair projects, new levee projects, development of levee maintenance corridors, or other levee improvement work. Day use areas are staging or access points to recreation spaces that have their own specific uses. Day use areas are composed of the following supporting measures: group picnic areas, play features, parking areas, restroom facilities, and signage. These amenities serve large groups and families and can be used for special events such as reunions, birthday parties, and weddings.

Day use area locations and design of these spaces will have to be carefully considered because some of the amenities associated with day use areas potentially could negatively affect the

surrounding environment. Barbeques and refuse from group picnic areas potentially could increase fire hazard risk to the surrounding habitat, contribute to poor water quality, or otherwise degrade the habitat.

7.1.5.3 River Access

The development of river access along levees and flood management lands could be part of levee repair projects, new levee projects, development of levee maintenance corridors, or other levee improvement work. River access facilities allow the public to directly engage the water safely at controlled locations. River access areas are composed of the following supporting measures: boat ramp, designated swimming area, fishing pier, parking areas, restroom facilities, signage, wildlife viewing platform, and vendor facilities for kayak, canoe, or raft rental.

The design of river access facilities will need to consider location of boat ramps, designated swimming areas, and fishing piers, as these three uses of the water pose obvious conflicts with each other and need adequate buffer space. The interface of these facilities with the water could alter or change currents or water flows, put humans in direct contact with fish habitat, and put users in direct contact with danger from currents and water flows.

7.1.5.4 Hunting and Fishing Facilities

The development of hunting and fishing facilities within levees and flood management lands could be part of levee repair projects, new levee projects, development of levee maintenance corridors, or other levee improvement work where space, safety concerns, and resources allow. Hunting and fishing facilities allow the public to engage in hunting and fishing activities in designated locations reducing potential conflicts with other users of the space. Hunting and fishing facilities are composed of the following supporting measures: shooting range, hunting blinds, fishing pier, parking areas, restroom facilities, and signage.

Consideration of locating hunting and fishing facilities in the landscape away from other recreation uses is important to minimize conflicts. Clear signage around recreation use interface areas (e.g., at edges of trails near hunting areas) is crucial.

7.1.5.5 Campground/Recreational Vehicle Park

Developing campgrounds and recreational vehicle (RV) parks could be part of levee repair projects, new levee projects, development of levee maintenance corridors, or other levee improvement work where space is adequate. Campground facilities allow users to interact directly with the environment around them. Having adequate facilities at campgrounds can help reduce litter, water quality conflicts, and negative environmental effects. Campground facilities are composed of the following supporting measures: camping site, RV connections, parking areas, restroom facilities, signage, and vendor facility for camping supplies.

Campgrounds and RV parks are used overnight, and therefore the location of these facilities needs to be planned carefully in consideration of the surrounding land uses. Barbeques and refuse from campgrounds potentially could increase fire hazard risk to the surrounding habitat, contribute to poor water quality, or otherwise degrade the habitat.

7.1.5.6 Public Education/Nature Center

The development of a public education or nature center could be part of levee repair projects, new levee projects, development of levee maintenance corridors, or other levee improvement

work where space and local infrastructure is adequate. Public education and nature centers allow the public to gain new understandings about the local environment, challenges this environment is facing, and how the visitor fits into the overall system. These centers attract the widest range of users from a large geographical area. Public educational and nature centers are composed of the following supporting measures: natural and cultural resource center, native plant demonstration garden, parking areas, restroom facilities, signage, wildlife viewing platform, and vendor facility for a restaurant and/or a gift shop.

Public education and nature centers require a greater amount of infrastructure, personnel, and utilities compared to other recreation facilities discussed in this study. Location of this type of facility would be best in or very close to a population center with easy access to utilities. Siting the facility out of danger of floodwaters, but close to the water, will be a great design challenge for this measure.

7.1.6 Site-Specific Recreation Opportunities

Multi-objective flood management actions, where feasible and appropriate, should incorporate open space and recreation opportunities that are consistent with the goals and objectives of the CVFPP. The Plan recognizes and builds upon the significant prior investment of time and resources expended by various local, State, federal, and non-governmental organizations that have identified many recreation opportunities in the Feather River Basin which could become part of the flood management infrastructure. The integration of these opportunities into flood management actions allows leveraging of funding and other resources from multiple sources because the projects provide multiple benefits to a wider variety of user groups and agencies.

Specific recreation primary measures that could be implemented within the Feather River Basin are shown below. Table 7-1 summarizes the relationship between primary and supporting measures and lists each primary measure by geographic location within the Feather River Basin. The ability of projects that include these recreation measures to meet multiple Conservation Strategy flood management, agricultural land preservation, and habitat enhancement objectives should be considered because projects that address multiple objectives are more likely to qualify for State cost-sharing under the CVFPP than recreation measures on their own.

Table 7-1. Recreation Measures and Potential Geographic Locations

Primary Measure and Geographic Location	Supporting Measures																	
	Boat Ramp	Camp Sites	Class I Bike Trail	Designated Swimming Area	Equestrian Trail	Fishing Pier	Group Picnic Area	Hiking Trail	Hunting Blinds	Native Plant Demonstration Garden	Natural and Cultural Resource Center	Parking Area	Play Feature	Restroom Facility	Shooting Range	Signage – Directional and Interpretive	Vendor Facility	Wildlife Viewing Platforms
Multi-use Trail Biggs to Thermalito Afterbay			X		X			X								X		
Multi-use Trail Thermalito Afterbay to Hixson Avenue			X		X			X								X		X
Multi-use Trail Hixson Avenue to East Gridley Road			X		X			X								X		X
Multi-use Trail East Gridley Road to Butte/Sutter County line			X		X			X								X		X
Multi-use Trail Sutter/Butte County line to Pennington Road			X		X			X								X		X
Multi-use Trail Pennington Road to Pease Road			X		X			X								X		X

Table 7-1. Recreation Measures and Potential Geographic Locations

Primary Measure and Geographic Location	Supporting Measures																	
	Boat Ramp	Camp Sites	Class I Bike Trail	Designated Swimming Area	Equestrian Trail	Fishing Pier	Group Picnic Area	Hiking Trail	Hunting Blinds	Native Plant Demonstration Garden	Natural and Cultural Resource Center	Parking Area	Play Feature	Restroom Facility	Shooting Range	Signage – Directional and Interpretive	Vendor Facility	Wildlife Viewing Platforms
Multi-use Trail Pease Road to Queens Avenue			X		X			X								X		X
Multi-use Trail Shanghai Bend to Nelson Slough			X		X			X								X		X
Multi-use Trail Butte County line to Riverfront Park			X		X			X								X		X
Multi-use Trail Riverfront Park to Feather River Floodway			X		X			X								X		X
Multi-use Trail Feather River Floodway to Star Bend Boat Ramp			X		X			X								X		X
Multi-use Trail Star Bend Boat Ramp to Feather-Bear River Confluence			X		X			X								X		X

Table 7-1. Recreation Measures and Potential Geographic Locations

Primary Measure and Geographic Location	Supporting Measures																	
	Boat Ramp	Camp Sites	Class I Bike Trail	Designated Swimming Area	Equestrian Trail	Fishing Pier	Group Picnic Area	Hiking Trail	Hunting Blinds	Native Plant Demonstration Garden	Natural and Cultural Resource Center	Parking Area	Play Feature	Restroom Facility	Shooting Range	Signage – Directional and Interpretive	Vendor Facility	Wildlife Viewing Platforms
Multi-use Trail Nelson Slough to Obanion Road			X		X											X		
Multi-use Trail Obanion Road to Wadsworth Canal			X		X											X		
Multi-use Trail Sutter Bypass to Sutter Bike Path			X		X											X		
Multi-use Trail Sutter Bike Path to Acacia Avenue			X		X											X		
Multi-use Trail Feather-Bear River Confluence to Wheatland			X		X			X								X		X
Day Use Area Gray Lodge							X					X	X	X		X		
Day Use Area Upper Butte Basin							X									X		

Table 7-1. Recreation Measures and Potential Geographic Locations

Primary Measure and Geographic Location	Supporting Measures																	
	Boat Ramp	Camp Sites	Class I Bike Trail	Designated Swimming Area	Equestrian Trail	Fishing Pier	Group Picnic Area	Hiking Trail	Hunting Blinds	Native Plant Demonstration Garden	Natural and Cultural Resource Center	Parking Area	Play Feature	Restroom Facility	Shooting Range	Signage – Directional and Interpretive	Vendor Facility	Wildlife Viewing Platforms
Day Use Area Hamilton Slough/ Thermalito Bay							X					X	X	X		X		
Day Use Area Hixson Avenue							X					X		X		X		
Day Use Area East Gridley Road							X					X	X	X		X		
Day Use Area Pennington Road							X					X	X	X		X		
Day Use Area Morse Road							X					X	X	X		X		
Day Use Areas Feather River Parkway							X					X	X	X		X		
Day Use Areas River Front Park							X					X	X	X		X		

Table 7-1. Recreation Measures and Potential Geographic Locations

Primary Measure and Geographic Location	Supporting Measures																	
	Boat Ramp	Camp Sites	Class I Bike Trail	Designated Swimming Area	Equestrian Trail	Fishing Pier	Group Picnic Area	Hiking Trail	Hunting Blinds	Native Plant Demonstration Garden	Natural and Cultural Resource Center	Parking Area	Play Feature	Restroom Facility	Shooting Range	Signage – Directional and Interpretive	Vendor Facility	Wildlife Viewing Platforms
Day Use Area Feather River Floodway Corridor							X					X		X		X		
Day Use Area Lake of the Woods							X					X		X		X		
Day Use Area Bobelaine/ Nelson Slough							X							X		X		
Day Use Area Gilsizer Slough							X									X		
Day Use Area Sutter National Wildlife Refuge							X							X		X		
Day Use Area Wadsworth Canal/Sutter Bike Path							X					X	X	X		X		

Table 7-1. Recreation Measures and Potential Geographic Locations

Primary Measure and Geographic Location	Supporting Measures																	
	Boat Ramp	Camp Sites	Class I Bike Trail	Designated Swimming Area	Equestrian Trail	Fishing Pier	Group Picnic Area	Hiking Trail	Hunting Blinds	Native Plant Demonstration Garden	Natural and Cultural Resource Center	Parking Area	Play Feature	Restroom Facility	Shooting Range	Signage – Directional and Interpretive	Vendor Facility	Wildlife Viewing Platforms
River Access Hamilton Slough/ Thermalito Bay	X			X		X						X		X		X	X	X
River Access East Gridley Road				X		X										X		X
River Access Feather River Parkway				X		X										X		X
River Access River Front Park				X		X										X		X
River Access Boyd's Pump				X		X										X	X	X
River Access Feather River Floodway Corridor				X	X	X										X		X
River Access FRWA – Lake of the Woods				X	X											X		X

Table 7-1. Recreation Measures and Potential Geographic Locations

Primary Measure and Geographic Location	Supporting Measures																	
	Boat Ramp	Camp Sites	Class I Bike Trail	Designated Swimming Area	Equestrian Trail	Fishing Pier	Group Picnic Area	Hiking Trail	Hunting Blinds	Native Plant Demonstration Garden	Natural and Cultural Resource Center	Parking Area	Play Feature	Restroom Facility	Shooting Range	Signage – Directional and Interpretive	Vendor Facility	Wildlife Viewing Platforms
River Access FRWA – Nelson Slough Unit	X					X						X		X		X		X
River Access Sutter National Wildlife Refuge					X											X		X
Hunting and Fishing Facilities Upper Butte Basin						X			X			X		X	X	X		
Hunting and Fishing Facilities FRWA – Nelson Slough Unit						X			X			X		X		X		
Camping Ground/ Recreational Vehicle Park Upper Butte Basin		X										X		X		X	X	
Public Education/ Nature Center Feather River Parkway										X	X	X	X	X		X	X	X

8 Structural and Operational Alternatives Formulation

This section will provide a list of management actions and projects for the region, including:

- Brief description of action and deficiency corrected
- Figure(s)
- Quantities
- Estimated Costs
- Regional Levee System Improvement Actions

8.1 Sutter Basin: Description of ongoing, planned, and potential actions

The Sutter Butte Flood Control Agency (SBFCA) is planning to improve 44 miles of levees from Thermalito Afterbay south to the Sutter Bypass (<http://www.sutterbutteflood.org/index.php/projects>, accessed 6-24-13) and has long-term plans to also make improvements to the Sutter Bypass levee. SBFCA has begun implementing the Feather River West Levee Project (FRWLP), a nearly 41-mile levee project from Thermalito Afterbay to approximately Laurel Avenue. The goals of the project are to reduce flood risk and remove more than 34,000 properties from FEMA Special Flood Hazard Areas. This includes increasing public safety by providing 200-year flood protection to Biggs, Gridley, Live Oak, and Yuba City, and providing 100-year flood protection for the less populated areas south of Yuba City (Figure 8-1).

The estimated project cost is \$312 million. DWR, however, has not yet agreed to cost-share the entire length of the project. For the portions that DWR does cost-share, the project is expected to be jointly funded by SBFCA and DWR, with each contributing 24 percent and 76 percent, respectively.

As described in this Plan, levees along the west bank of the Feather River currently do not provide 100-year flood protection, primarily because they suffer from potential underseepage and through-seepage.

Portions of the levees in the project area will be made stronger by constructing new cutoff walls or replacing existing cutoff walls, placing stability berms and installing seepage berms. These levee improvements block or slow the flow of water through and underneath the levees and

improve levee stability during high flood stages. Not all 44 miles of levees will need these improvements. More than 80 percent of the needed levee repairs will involve the construction of slurry walls, some as deep as 110 feet. In a few select areas, berms constructed on the land side of the levee were determined to be the best fix.

The West Feather River Levee is a far more dangerous structure than the Sutter Bypass East Levee based on performance history and geomorphology. Several levee failures in the area occurred due to geotechnical failures (non-overtopping) in the past 100 years, whereas the Sutter Bypass East Levee has no documented failures. Conversely, State and federal risk assessments portray relatively equivalent hazards.

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Sutter Butte Flood Control Agency Feather River West Levee Project Area Map

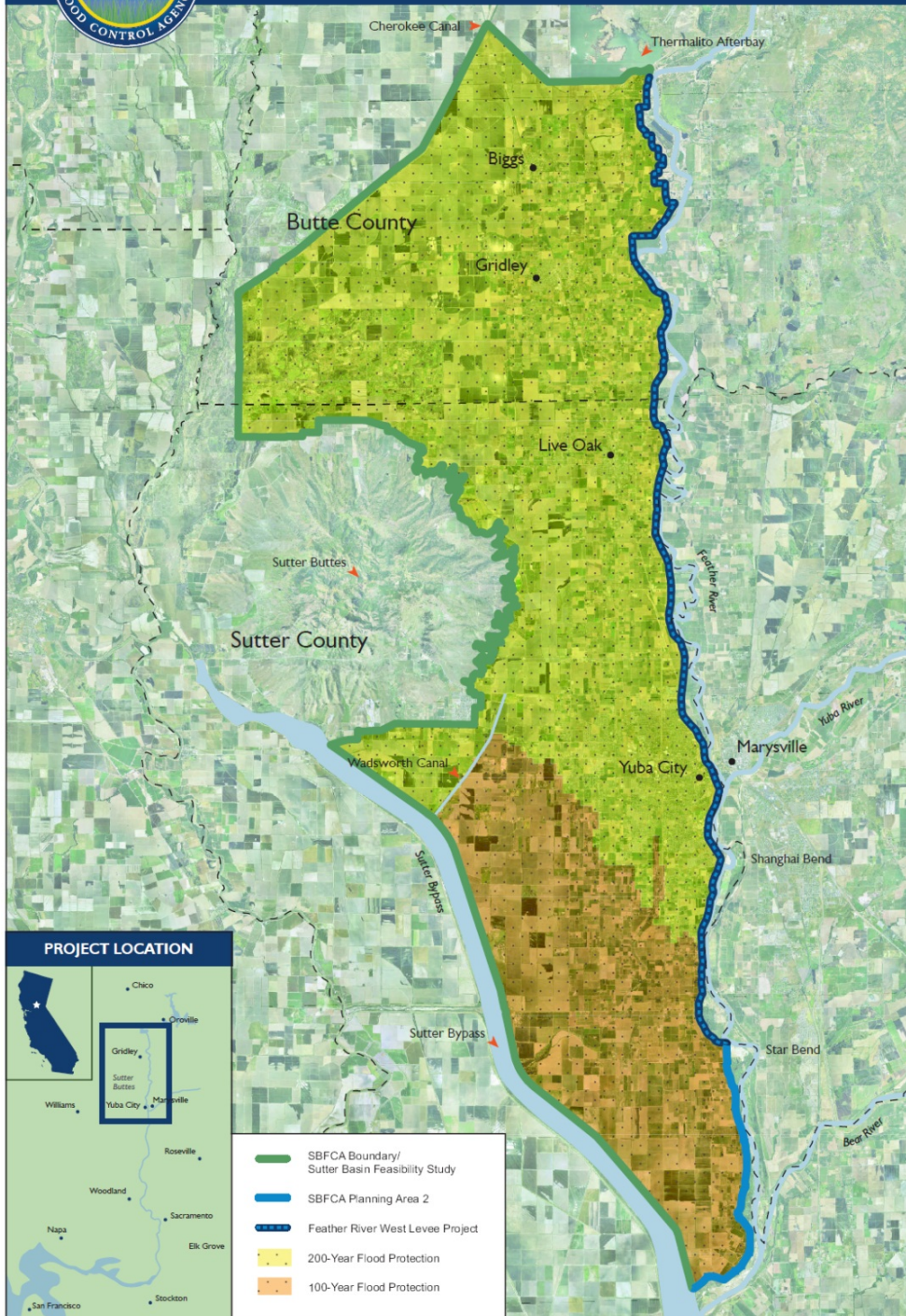


Figure 8-1. Feather River West Levee Project

The first reach of FRWLP work awarded is currently on schedule and within budget. Early stages of construction started in late July 2013, with project completion slated for late 2015. SBFCA's top priority is to complete the FRWLP as planned.

SBFCA has taken the lead on this work, in partnership with the State (CVFPB and DWR) to expedite the much-needed levee improvements. However, both SBFCA and the State seek maximum federal cost-sharing in these levee improvements and are therefore partnering with USACE in the federal project formulation process for the same study area. Since 2000, USACE has been working on a feasibility study for the area. On June 14, 2013, the draft Sutter Basin Feasibility Study and Environmental Impact Statement were released for public review and comment. The final document would serve as the basis for potential federal participation in the project, including cost sharing.

In its draft documentation USACE recommends the Locally Preferred Plan (LPP) as the Tentatively Selected Plan (TSP), which involves improving the west levee for 41 miles (Thermalito Afterbay to south of Laurel Avenue). However, only the National Economic Development (NED) Plan is recommended for full federal cost-share, meaning that if approved the federal government would participate in the construction of the entire 41 miles, but would only cost-share in a portion of it.

SBFCA is investigating several options for improvements to the southern-most levees of the Feather River and also to the Sutter Bypass. First, construction of some of the levees could be advanced by USACE pursuant to the Sutter Basin Project. Second, some levees could be improved using funding from DWR's Flood System Repair Project. Third, SBFCA has funding available to initiate additional locally-proposed levee improvements. Fourth, DWR's advancing of system-wide improvements under the CVFPP could result in levee modifications benefiting the southern portions of the basin. As to any of these options, or others that could become known, SBFCA will work closely with DWR to identify and correct known problem spots along the levee system to rapidly improve the level of flood protection for the southern portion of the basin. Subsequently, SBFCA will formulate a phased plan of additional levee improvements that will lead to the equivalent of 100-year flood protection for this area.

In addition, the areal extent of flooding in the southern portion of the Sutter Basin is controlled by the extent to which floodwaters pond behind the levees at the southern end of the basin. Most conservatively, if it is assumed that the levee remains intact even after overtopped, resulting in a surcharged water surface elevation above the lowest top of levee elevation, the backwater effect would substantially extend into the southwestern quadrant of Yuba City's sphere of influence. Even if it is assumed that the levee is breached, either through erosion or constructed breach, when the water reaches the levee crown, a portion of Yuba City remains within the 100-year Special Flood Hazard Area (SFHA).

Therefore, SBFCA is considering, as a residual risk alternative, the construction of a designated spillway of appropriate width at the southern end of the basin, which would allow the floodwaters to drain from the Sutter Basin two to three feet below the levee crown. The spillway could be armored to prevent erosion and sealed with a fuse plug that could be released through the use of explosives or other means in the event of flood waters accumulating within the basin. Such a fuse plug weir about two miles long could reduce flood elevations within the basin by two to three feet.

This conceptual alternative formalizes the past practice of breaching levees to allow flood waters to drain out of a basin when a levee failure has already occurred, thus preventing or reducing the consequences of interior basin flooding. In 1955, the lower Feather River was breached following the levee failure at Shanghai Bend, and in 1997 relief cuts were made on the Sutter Bypass and Bear River levees for this purpose.

The impacts of hastening the drainage of flooded islands on the regional flood stages through the use of designated spillways vary depending upon the specific storm and breach scenario and can be modeled using currently available system hydraulic modeling tools such as the Central Valley Flood Hydrology Study HEC-RAS model or the Central Valley Floodplain Evaluation and Delineation HEC-RAS model. In general, the impacts on stages in the system are unlikely to substantially affect flood risks for other leveed areas in the system.

The concept of designating a spillway at the southern end of the Sutter Basin is a preliminary concept at this time. By formalizing a relief cut in the southern Sutter-Butte basin, the location which causes minimal impacts on adjacent levees could be identified, the process would be documented in the O&M manual for the levee, and affected property owners and other stakeholders would be fully informed and consulted regarding potential consequences as opposed to the current ad hoc process that takes place during a flood fight. In short, the important issues of compensation, indemnification, post-flood recovery and liability would be worked out prior the flood event, thus minimizing damages to affected parties. If and when SBFCA gives this concept detailed consideration as part of its comprehensive flood risk reduction program, all affected parties will be notified and consulted. Detailed engineering and hydraulic studies will be completed.

SBFCA's proposed structural levee improvements are tabulated in Table 8-1.

Table 8-1. SBFCA Proposed Levee Improvements

ID	Description	Estimated Cost	Comments
L1	FRWLPI, Thermalito to Laurel Avenue, achieve 200-year protection for urban areas, cost-shared with State	\$290 M	Highest priority, to provide 200-year protection. Construction to start July 2013
L2A	Star Bend to Laurel Avenue	\$60 M*	
L2A	Laurel to Cypress Critical Repair	\$13.5 M	
L2A	Star Bend South Critical Repair	\$8.8 M	
L2B	Additional projects to achieve 100-year flood protection for the southern portions of the basin, cost-shared with the State, and collaborate with the State on comprehensive repairs or replacement of the Sutter Bypass East Levee. In parallel, repair critically damaged levees on the existing West Feather River levee and Sutter Bypass, and achieve a FEMA Ag Zone coupled with	\$191 M*	Improve rural-ag flood protection. Enable rural economy to thrive, thereby reducing floodplain development pressure.

	affordable insurance premiums		
L4	Gridley Bridge Bank Erosion Repair Design, Permitting, and Construction	\$5.5 M	
L5	Oroville Wildlife Area Flood Stage Reduction Project design, permitting, and construction. Includes the design of weir improvements and ecosystem restoration to improve connectivity to historic floodway and reduce stages in main channel of the Feather River.	\$5.5 M	The primary goal of the project is to divert water from the Feather River through the Oroville Wildlife Area to accommodate up to 80,000 cfs for a 200-year flood event. Project will fund project management, hydraulic modeling, feasibility, design, environmental documentation, and permitting. the site encompasses about 1,000 ac.
L6	Rural Levee Reliability Study	\$1.0 M	
L7	Sutter Bypass Wadsworth Critical Repairs	\$0.46 M	

* Estimates from North NULE Study Area Remedial Alternatives and Cost Estimates Report (RACER)

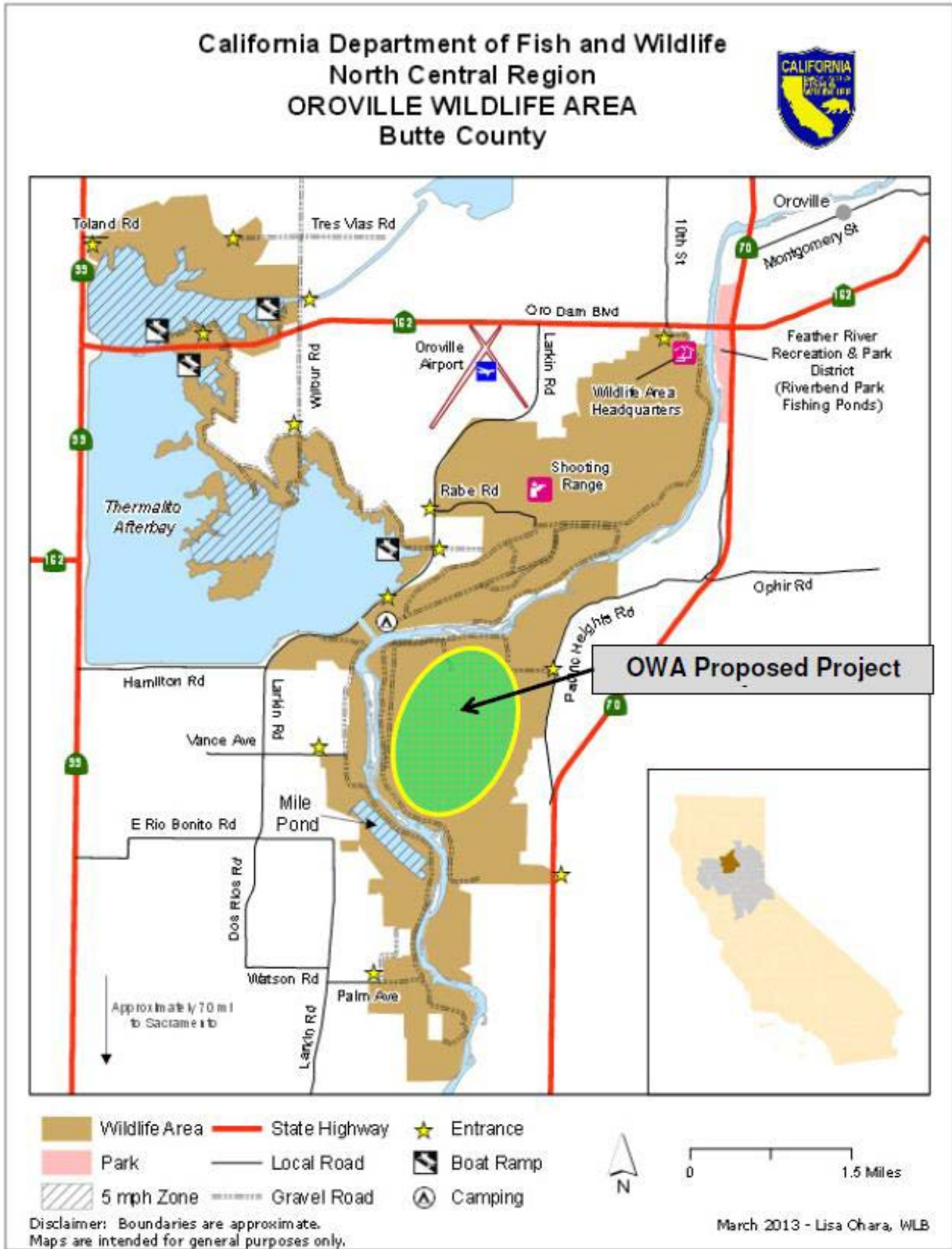


Figure 8-2. Oroville Wildlife Area

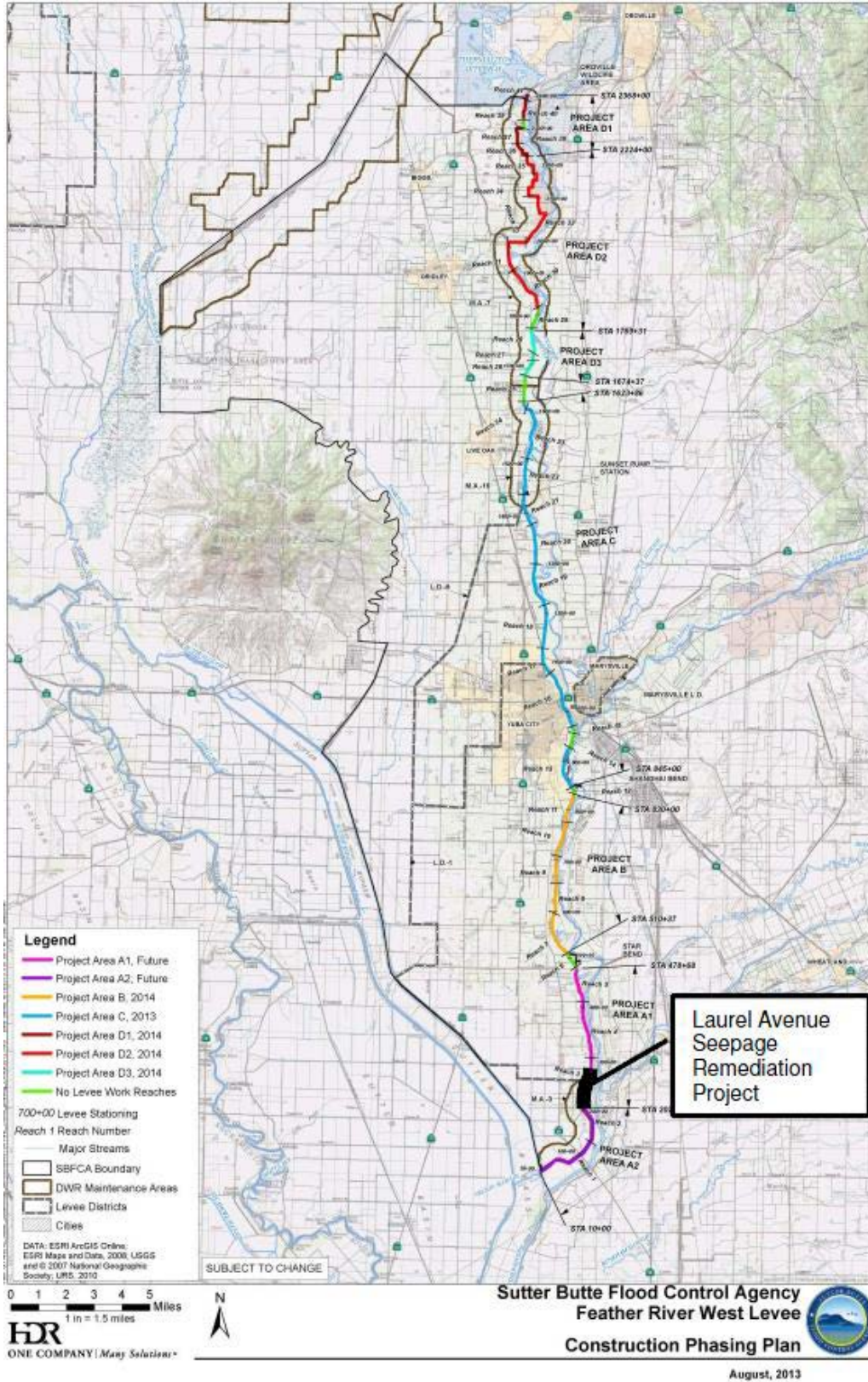


Figure 8-3. Construction Phasing Plan



Figure 8-4. Active Erosion Site Map

8.1.1 Cherokee Canal Projects

The 2012 CVFPP discussed the possibility of expanding and extending the Cherokee Canal to act as a Feather River Bypass. Consistent with the input provided to the CVFPB during the CVFPB adoption process, the region remains concerned about the potential loss of agricultural lands, redirected hydraulic impacts, and public expense associated with creation of a new Feather River Bypass. While the Feather River Bypass does have the potential to reduce the flood risk of the urban communities in the Feather River Region, the impacts and costs do not appear to justify further consideration of this alternative. Therefore the locally preferred plan for addressing the long-standing concerns surrounding Cherokee Canal does not include the creation of a Feather River Bypass. Locally preferred management actions include:

Cherokee Canal Corridor Management Plan (CCCMP)

Develop a long-term Corridor Management Plan that establishes a regular schedule for clearing vegetation and removing sediment. The CCCMP should examine the entire system of the Cherokee Canal and not revolve around a ‘segment by segment’ approach. The plan could include staged vegetation removal to allow portions to remain, for example: clear one third of the channel every five years or clear the center and leave some along the edges. The CCCMP will need to have a long-term and reliable funding source to ensure deferred maintenance does not result in the same existing situation occurring in the future.

Cost saving options should be explored for contracting with locals to perform maintenance activities. The CCCMP should recognize and protect the benefits and value of existing Giant Garter Snake habitat provided by adjacent private property rice lands, in addition to the habitat concept of ‘quality’ over ‘quantity’. Options may also exist to coordinate rice field operations with the local rice growers association (i.e. do not flood specific rice fields during the fallow season to improve GGS habitat), or to restore areas just outside of the canal, in exchange for less restrictive permitting requirements inside the levees. The goal of the CCCMP should be the incremental restoration of design channel capacity over time, while preserving and enhancing regional habitat quality centered on the Cherokee Canal corridor.

Sediment Detention Basin and Beneficial Reuse of Sediment

Construct one or more sedimentation basins at the upper end of the canal where it can effectively capture hydraulic mining sediment deposits as they are mobilized during flood events. Such sedimentation basins could be located upstream of Cottonwood Creek up to, and including, the former site of the hydraulic debris dam east of Highway 149. A key consideration from the local perspective is that the required real estate needed for such a facility, or facilities, should be acquired on a willing seller basis, taking into consideration potential impacts on land use of both the land to be acquired and surrounding lands.

Sedimentation basins must be excavated regularly to maintain their function. This offers the possibility of beneficial reuse of sediment for a variety of uses in the region, depending upon the quality and particle size of the sediment deposits. Local property owners have found excavated sediment to be useful for a variety of uses in the past.

Levee Improvements

Levee raises/repairs should be implemented—either as a part of ongoing channel maintenance or separately. The right bank reach upstream of the Richvale Highway Bridge downstream to the

UPRR trestle should be the priority area, as this stretch of levee protects existing infrastructure including portions of the small community of Richvale, highly valued agriculture processing and storage facilities, wastewater treatment facilities, local public water supply wells, and a local fertilizer plant. Existing studies show that by simply continuing the grade from the 1974 levee raise (i.e., use the same slope and tie in to the downstream elevation of the levee raise) from the Richvale Highway Bridge to the UPRR would likely solve the issue of overtopping in this area.

Bridge Crossing Improvements

As noted in Section 4.4.1.4, bridge crossings pose flood conveyance problems due to capacity constraints and floating debris accumulation. From upstream to downstream, the main bridge crossings include:

1. Nelson Road Bridge
2. Nelson-Shippee Road Bridge
3. Richvale Road Bridge
4. UPRR Bridge
5. Highway 162 Bridge

This Plan recommends that these road crossings be improved to eliminate flow constrictions and debris buildup during high water events, beginning with the UPRR railroad crossing and Richvale Highway Bridge.

Relief Weir

Given that Cherokee Canal is only designed to provide 25-year protection, this plan proposes to designate the least damaging location for discharging excess floodwaters in the event of a storm which exceeds its design capacity. A weir of appropriate elevation and length would allow for the controlled discharge over the left bank levee to the south of the Canal upstream of Richvale, to a designated overflow area. This management approach would include the acquisition by the CVFPB of flood inundation easements from willing property owners, assuming all affected property owners supported such an approach. A preliminary review of existing studies indicates that overflows escaping outside of the channel would flow somewhat adjacent to the existing canal and eventually end up in the Butte Sink.

Update the current FEMA maps

Produce accurate FEMA maps of the area. The area is currently an “A” zone with no identified flood elevations. Accurate maps would provide the necessary information for flood proofing or re-building infrastructure.

Table 8-2. Cherokee Canal Management Actions

ID	Description	Estimated Cost	Comment
L1	Develop Corridor Management Plan		
L2	Sedimentation Basin(s)		
L3	Levee improvements – Right Bank near Richvale		
L4	Bridge Crossing Improvement		
L5	Relief Weir, Left bank upstream of Richvale		
L6	FEMA Remapping – MA 13		

8.1.2 Reclamation District 10: Description of Ongoing, Planned, and Potential Actions

Reclamation District 10, commonly referred to as District 10, includes about 12,000 acres of land along the east bank of the Feather River between Honcut Creek on the north and Jack Slough on the south (Yuba County, 2007). It is protected from local drainage, including Jack Slough by the Western Pacific Railroad embankment on the east. Its 23.4 miles of levees originate on high ground (about 100 feet elevation (USGS, 2011)), follows the south bank of Honcut Creek to the Feather River, downstream to Simmerly Slough, upstream to the WPRR and north along the railroad embankment for six miles to high ground (Figure 8-5)

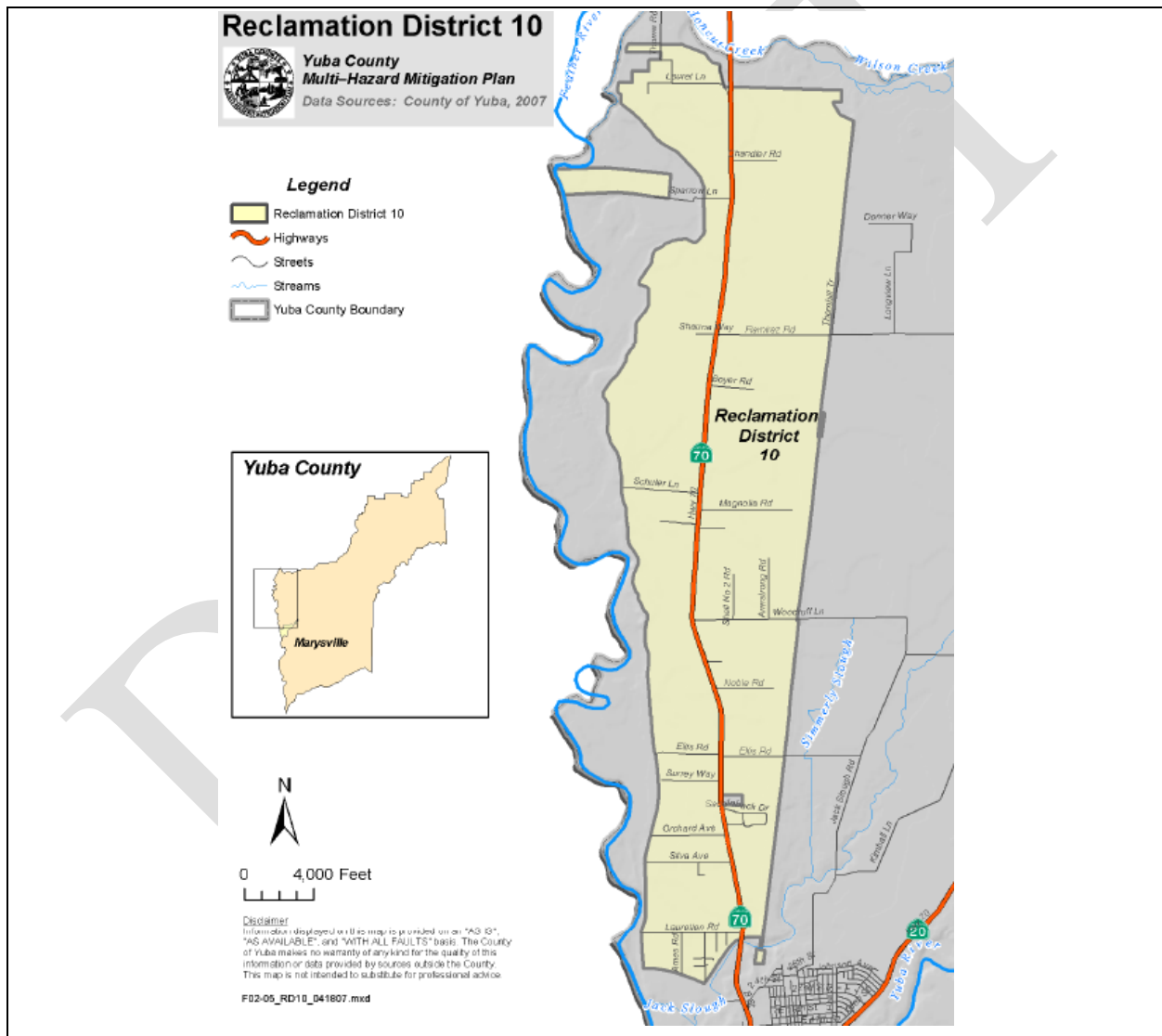


Figure 8-5. Reclamation District 10
 Source: Yuba County 2007

The district is primarily devoted to agriculture, with 31 farms, 13 agriculture-related businesses, and small businesses along Highway 70, which transects the district from north to south. There are about 320 residences within the district housing a population of 1,260 (Yuba County, 2007).

District 10 was established in 1913 as a volunteer organization. Levee maintenance work was mainly accomplished by volunteers, using privately owned equipment. In spring 2008, RD 10 conducted a Proposition 218 Assessment election, which resulted in the establishment of an annual assessment for operation and maintenance of the district levee system, beginning with Fiscal Year 2008-09. The assessment is distributed among the benefiting properties within the district in proportion to benefits received. It includes a provision for annual increases in proportion to the change in the Consumer Price Index for San Francisco, with a cap of four percent per year. The assessment for the 2013-14 Fiscal Year is \$100,220, which is supplemented with a \$20,000 grant from Yuba County, for a total operating budget of \$120,220 (June 2013 – SCI Consulting Group).

District 10 flooded in 1937. After the February 1986 flood, USACE launched a phased reevaluation of the Sacramento River Flood Control Project. Phase II of that project evaluated the Marysville-Yuba City area. USACE recommended, as part of the regional levee reconstruction effort, that 2.65 miles of levee in Unit 2 along the Feather River be strengthened with a toe berm and drain, which were constructed in 1996 (Figure 8-6).

Severe erosion of about 150 feet of the Simmerly Slough levee at LM 1.17 occurred during the December 2005 to January 2006 event, which was repaired under PL84-99 by USACE (Yuba County 2005).

District 10 also suffers from flooding due to internal drainage from Dry Creek, which must be addressed through drainage pumping. Such internal pump stations can be overwhelmed in major winter storm events such as occurred in January 1997.

As described in Section 3.1, the non-urban levees of the district do not meet USACE standards for levee geometry due to overly steep waterside and landside slopes. The historical records indicate that cracking, erosion, and seepage have occurred in the past.

District 10 proposes to work with the State and USACE to improve its levee system over time, on a worst-risk-first basis. This will require more detailed studies of the district’s levee system, design, and construction.

Among the highest priority actions are ensuring the integrity of the all-weather patrol road on the levee crown, addressing known seepage sites, preventing future erosion at vulnerable sites, and improving levee geometry deficiencies, prioritized based on flood risk. In addition, District 10 will seek to improve drainage of ponded seepage where it could potentially affect visibility, flood fight access, and levee stability. Proposed actions for District 10 are summarized in Table 8-3.

Table 8-3. District 10 Levee Improvements

ID	Description	Estimated Cost	Comments
L1	All-weather patrol road improvements (augment aggregate base, grading)	\$930,000	Preliminary, Planning Level Estimate
L2	Improved rodent control and rodent	\$950,000	Preliminary, Planning Level

	burrow mitigation		Estimate
L3	Seepage and underseepage site remediation	\$1.6 M	Preliminary, Planning Level Estimate
L4	Erosion protection at identified sites vulnerable sites	\$1.0 M	Preliminary, Planning Level Estimate
L5	Improve drainage along levee landside toe to improve visibility, flood fight access, and levee stability	\$740,000	Preliminary, Planning Level Estimate
L6	Evaluate, design, and construct levee improvements to achieve USACE project levee geometry and stability standards-- prioritized based on risk	\$175.66 M*	

* Estimates from North NULE Study Area Remedial Alternatives and Cost Estimates Report (RACER)

8.1.3 Marysville Ring Levee System: Description of ongoing, planned, and potential actions

The Marysville Ring Levee project is a four-phase, \$90.5 million project (USACE, 2013) to upgrade the levee surrounding Marysville. The project will strengthen the existing levee by constructing deep cut-off walls, seepage-berms and other measures to reduce the likelihood of floodwaters seeping through or under the ring levee. The MLD, USACE, and CVFPB are collaborating on the project. USACE is implementing the project and the CVFPB and MLD are the non-federal sponsors for the project. Based on current estimates, these repairs are expected to provide approximately 250-year level of flood protection, exceeding the 200-year level of flood protection required by SB 5 (Machado, 2007) and incorporated into the urban level of flood protection criteria set forth in the CVFPP (YCWA, 2013) <http://www.ycwa.com/ring-levee>, accessed 6-24-13).

USACE initiated the feasibility study for the Yuba River Basin in 1987 (P.L. 99-591), leading to the completion of the Yuba River Basin Project Feasibility Report and Final Environmental Impact Statement/Environmental Impact Report (EIS/EIR) in April 1998. A Report of the Chief of Engineers, dated November 25, 1998, summarized the findings of the 1998 Final Feasibility Report after its approval. In 2008, the Marysville Ring Levee was approved as a separable element of the 1998 Feasibility Study for the Yuba River Basin Project. Based on a greater understanding of under seepage in the region from post-authorization studies, the Marysville Ring Levee element has moved forward and design refinements have been defined. The project was initiated in 2010 with the approval of an Engineering Documentation Report (EDR) and the execution of a Project Partnership Agreement (PPA) between USACE, CVFPB, and MLD. An Environmental Assessment/Initial Study was completed and the project was found to have no significant environmental impacts with certain mitigation. The project was divided into four phases as shown in Figure 8-7. Marysville Ring Levee USACE Phased Reconstruction Plan Construction of Phase 1 began in September 2010 and was completed in 2012.

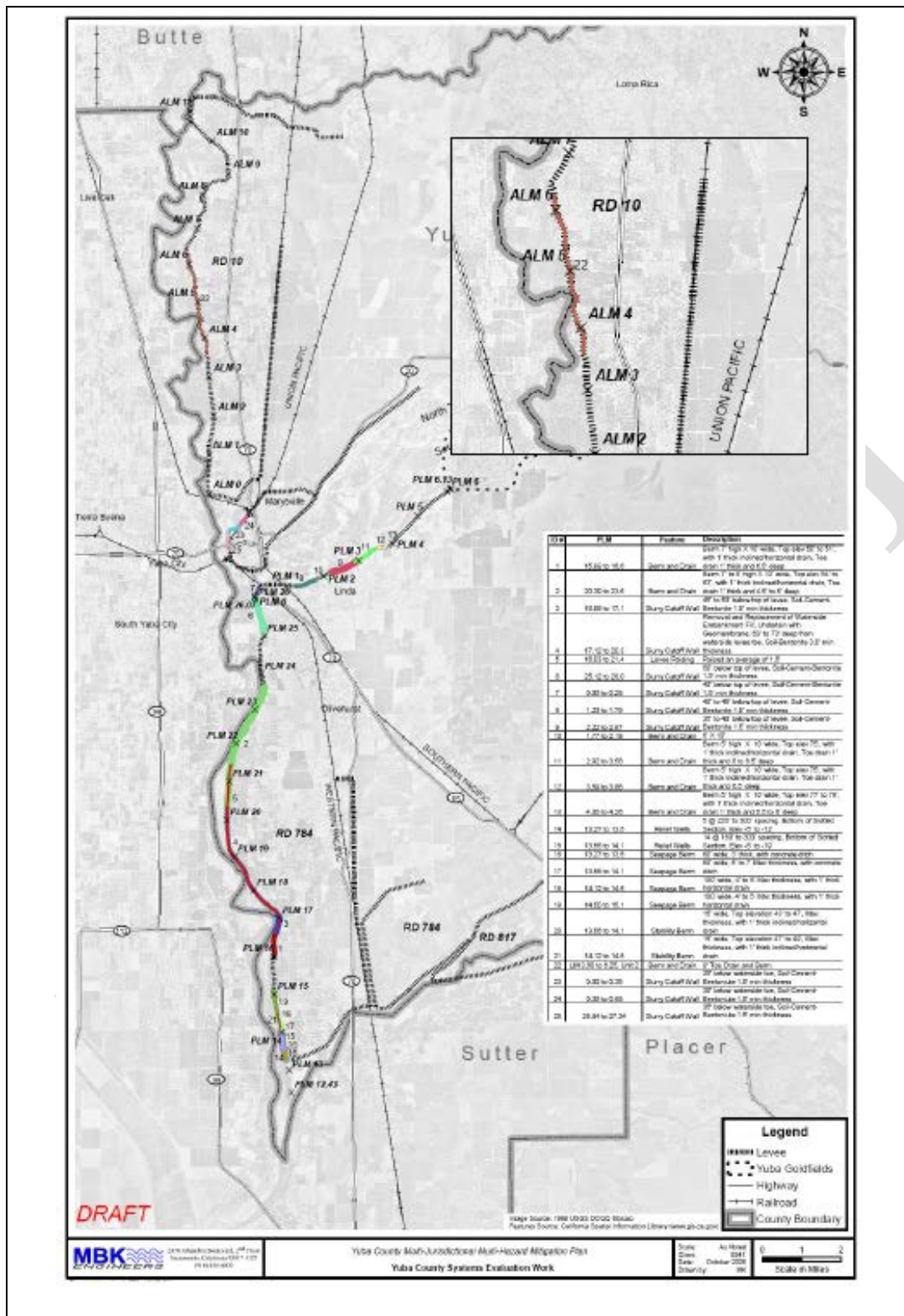


Figure 8-6. Reclamation District 10 Levees Repairs

Source: Yuba County 2007

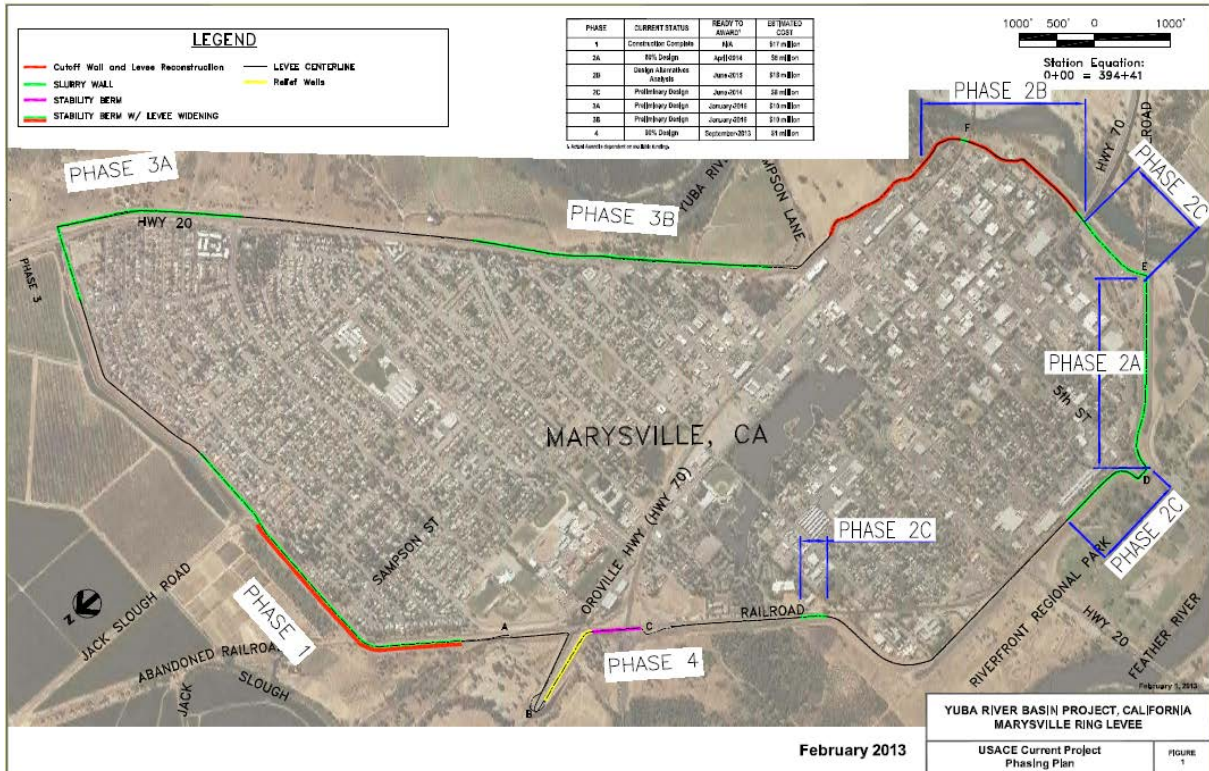


Figure 8-7. Marysville Ring Levee USACE Phased Reconstruction Plan

Source: USACE, 2013

This work consisted of upgrading the levee's fragile northeast reach by installing a seepage cutoff wall to depths of over 100 feet.

Design and planning are underway on phases 2, 3, and 4 of the project. Several stages for phases 2 and 3 could be ready for construction in late 2014 and/or early 2015. The likely next phase will be to strengthen the levee adjacent to Highway 70 and the Catholic cemetery using a stability berm. Work is slated to begin as early as December 2014. Design work also continues on levee sections near the Fifth Street Bridge with construction currently scheduled for 2015.

Total project costs are estimated at \$90.5 million. After phase 1, the remaining costs are roughly \$70 million. USACE is also preparing a plan to ensure the State and MLD are not required to finance any additional project costs, above their 5 percent cash requirements. This initiative is based on commitments by the Assistant Secretary of the Army (ASA) to allow advanced investments by the non-federal sponsors in the Yuba River Basin project, of which Marysville is a separable element, to count toward their cost-share for the Marysville repairs. DWR, YCWA, and MLD are working with USACE on the non-federal crediting plan. This plan was approved in April 2014.

The currently proposed action is to continue to support USACE efforts to complete all of the phases of the project and then implement operation and maintenance consistent with current urban levee maintenance criteria. A potential implementation concern is the meager pace of federal project funding appropriations, which is less than \$2 million per year. The non-

federal contributions have already been provided in the form of credit from past construction work in the area, and the State and MLD have also contributed over \$8.2 million of non-federal cash that exceeds the project's 5 percent cash requirement. FEMA's Provisionally Accredited Levee (PAL) rating expired in June 2010, which could lead to re-mapping of the city with less than 100-year flood protection if the pace of project implementation lags substantially behind the projections provided in MLD's PAL application. As a result of the slow pace of implementation, the State and MLD may consider taking the lead on a portion of the remaining work to expedite its completion.

MLD may also need to make improvements in the levee patrol road surface to assure all weather access during high water events. MLD projects are summarized in Table 8-4.

Table 8-4. Marysville Levee District, Proposed Levee Improvements

ID	Description	Estimated Cost (\$M)	Comments
L1	Phase 1	\$20.8M	Complete
L2	Phase 2 levee improvements	\$39.2M	
L3	Phase 3 levee improvements	\$26.6M	
L4	Phase 4 levee improvements	\$3.9M	
L5	All weather levee patrol road surface improvements		Under consideration
	TOTAL	\$90.50	

8.1.4 TRLIA: Description of ongoing, planned, and potential actions

RD 784, the Yuba County Water Agency, CVFPB, DWR, and USACE have contributed to efforts to provide improved flood protection to the RD 784 area, beginning after the disastrous flood of 1986 in which the failure of the Yuba River south levee adjacent to the town of Linda resulted in flooding of the district. Another levee failure resulted in flooding of RD 784 during the New Year's Flood of 1997, leading to a better understanding of the causes of levee failures and providing the impetus for additional efforts to reduce flood risks.

TRLIA was established in 2004 to lead the effort to achieve 200-year flood protection for RD 784. Four work phases were identified to achieve that goal along the Yuba, Feather, and Bear rivers and the Western Pacific Interceptor Canal.

To date, more than \$405 million has been invested in flood protection improvements for the urban areas, approximately half of which is being paid for by the State of California. These improvements include strengthening the left bank Yuba River levee, strengthening and setting back the Feather River left-bank levee from the Yuba River to the Bear River (the bulk of the TRLIA Improvement Program), strengthening and setting back the Bear River right-bank levee, and improving the Western Pacific Railroad Canal (WPRR), also referred to as the WPRR Interceptor Canal levee (WPIC) (Figure 8-8).



Figure 8-8. Levee Improvements TRLIA Project Area

Source: TRLIA, http://featherriversetbacklevee.com/downloads/PhaseMap_2009Brochure.pdf

FEMA accredited the levees protecting RD 784 in 2010, and as a result, only those areas subject to interior drainage flooding are mapped as Special Flood Hazard Areas.

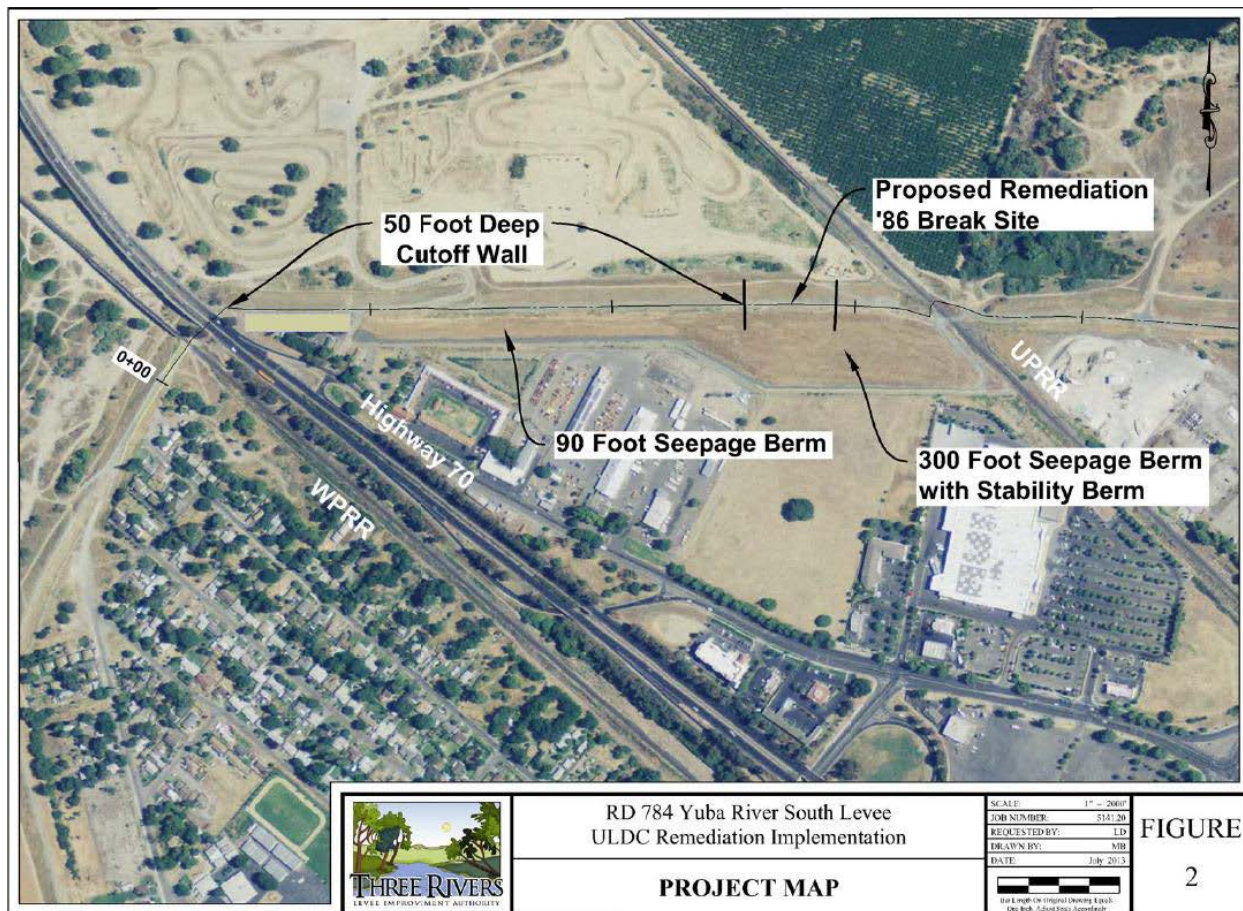
Subsequently, DWR and TRLIA identified additional work that needed to be completed along the Western Pacific Railroad Canal levee to meet the State 200-year levee design criteria, as well as various access and encroachment issues that need to be addressed.

FEMA has granted TRLIA provisional accreditation for the remaining work, given TRLIA’s plan for expediting the remaining work. The work has been completed as planned. TRLIA provided FEMA with certification of the completed work in a letter dated November 20, 2013.

RD 784 also maintains the Bear River right bank levee upstream of the WPRR drainage canal, which forms the southern boundary of a 2600-acre area locally referred to as “the Horseshoe,” which includes portions of RD 784 and 817. The western boundary of this area is the left-bank levee of the WPRR Interceptor Canal and the northern boundary is the left-bank levee of Best Slough. These 6.6 miles of levees were recently ranked “unacceptable” by the Periodic Inspection Report (USACE), due to excessive vegetation, encroachments, erosion, depressions, and rodents. RD 784 and affected landowners are exploring a range of options (including funding) for the Horseshoe area, ranging from restoration of the levees and design standards to levee degradation and floodplain restoration. TRLIA projects are summarized in Table 8-5.

Table 8-5. TRLIA, Proposed Levee Improvements

ID	Description	Estimated Cost	Comments
L1	Phase IV—Complete WPIC levee improvements	\$15.2 M	To be constructed 2013-2015
L2	Resolve ROW and encroachment issues for levees protecting urban areas	\$5 M – \$10 M	To be addressed 2013-2015
L3	Yuba Goldfields	\$15 M - \$50 M	Alternative analysis underway now to adopt as part of the SPFC
L4	Olivehurst Detention Basin	\$0.0 M	Construction completed. Action is to adopt as SPFC facility
L5	TRLIA is planning to perform additional explorations and implement a levee widening project to provide up to 200 year level of protection on a small section of the Yuba River South Levee. The proposed reach is a site of a 1986 levee break in which the USACE repaired using large rocks and unknown material. The proposed project will fund geotechnical explorations, design, construction, and management.	\$1.5 M	Stability of the reach is unknown. DWR ULE results may indicate potential instability within foundation of the embankment.



8.1.4.1 Yuba Goldfields

The RD 784 Levee System is part of the Sacramento River Flood Control Project (SRFCP). In a 1953 memorandum between the federal government and the State of California, the Yuba Left Bank (South) Levee of the SRFCP was described as extending from the “Feather River to high ground” for an approximate distance of 7.2 miles. The high ground referred to in the memorandum is the Yuba Goldfields (Goldfields). The Goldfields is an area of dredged tailing mounds that gives the appearance and has historically served the purpose of high ground. The determination by federal, State, and local flood management that the project levee tie into high ground is a fundamental assumption of the SRFCP.

The TRRIA team has evaluated the topography and hydraulics of the Goldfields and looked at a range of flood failure scenarios. The team has determined that the Goldfields does not function as high ground during large flood events and instead relies on a number of mine tailing piles to prevent flood waters from exiting the Goldfields. Research of the history of the determination of high ground indicates that the determination was made based on the SRFCP design flow of 120,000 cfs in the Yuba River. The flow was increased to 180,000 cfs in 1970 as part of the authorization for New Bullards Bar Dam. However, the team was unable to locate documentation that the USACE or State reaffirmed that the Goldfields would function as high ground at this higher flow. In addition, mining activities consisting of aggregate extraction and dredging for gold, have also significantly affected the landscape without an understanding of how these actions affect the flood risk in the area. These activities have created uncertainties as

to the Goldfields' ability to serve as high ground and prevent Yuba River flood flows from flanking the SRFCP. If the Goldfields cannot contain Yuba River flood flows with certainty, then the SRFCP could be flanked and flooding would occur in the RD 784 urban area. Not evaluating the impacts of the authorized objective release along with the mining activities creates a legacy problem for the SRFCP at its juncture with the Goldfields. Actions within the Goldfields to sustain the high ground nature of the Goldfields are integral to the authorized flood protection purpose of the SRFCP and should be included as part of the SRFCP.

With this better understanding of the flood threat from the Goldfields, TRLIA has developed a phased approach to managing flood risk in the Goldfields. The first step was to work with mining interests to construct non-leveed embankments in 2011 to address the highest risk areas See Figure 8-6. Step 2 is to construct features that address moderate risk in 2014 that will meet FEMA standards. Step 3 is to identify features that will meet the State of California's 200-year requirements. Step 4 is to construct the features identified in Step 3, which will be completed prior to 2025.

Work Plan

With the Goldfields flood threat verified by more recent information and a more stringent analysis; and the mechanism of flooding identified in detail, TRLIA developed a four-step work plan for reducing the flood threat and eventually providing sustainable 200-year flood protection for RD 784. TRLIA identified some available funding to initiate the work plan.

Step 1: Consisted of immediately modifying locations within the Goldfields mining areas that had been identified in a TRLIA October 2010 analysis as potential flow paths and completing agreements with mining operators to establish maintenance responsibilities for these features. TRLIA negotiated and signed contracts with the mining companies in the Goldfields to increase the height of dredge tailings mounds at three locations using the mining companies' authorities to mine in the Goldfields area. This was accomplished in 2011 (Figure 8-6).

Step 2: Will entail modifications of any additional mining areas that are subsequently identified as necessary to certify that the RD 784 area meets FEMA's criteria for a 100-year flood event. TRLIA has performed additional geotechnical and geomorphic evaluations and hydraulic modeling to determine that the Goldfields cannot reliably retain 100-year flows. Additional modifications to the Goldfields are needed to retain the 100-year flow and TRLIA has developed and is implementing a plan to construct these improvements. TRLIA plans to begin implementation of Step 2 solutions in 2014.

Step 3: Will develop a sustainable 200-year plan involving all stakeholders (federal, State, local, and private) that:

- Ensures future mining operations do not increase flood risk
- Provides sustainable 200-year flood protection for the RD 784 area
- Repairs or enlarges land features identified that are needed for 200-year flood protection
- Maintains the modified land features identified as needed for 200-year flood protection

This step is proposed to be completed by September 2014 and is one of the purposes of a feasibility study underway that is being cost-shared with DWR. The accomplishment of this task will take cooperation from all involved parties: Mining Companies, USACE, BLM, CVFPB, DWR, SMGB (Mining and Geology Board), Yuba County, RD 784, YCWA, and TRLIA. TRLIA has formulated four alternatives to provide 200-year protection. Three involve modifications of dredge tailings embankments within the Goldfields and the fourth is a levee south of the Goldfields. All four alternatives are being environmentally evaluated in an Environmental Impact Report and the complete evaluation of the four alternatives will be presented in the DWR cost-shared Final Feasibility Report.

Step 4: Will implement the 200-year plan developed in Step 3. Physical modifications to the Goldfields as identified in the sustainable 200-year plan will be accomplished. This step will also require the implementation of a long-term mechanism for governance and oversight of Goldfields mining operations to ensure and sustain 200-year protection. This effort will need to be funded by both State and local funding. State funding may require that the identified Goldfields 200-year project be included in the SRFCP. This step is proposed to be completed by 2025 or earlier to meet the SB 5 date that requires a 200-year flood protection plan be implemented before urban areas can continue to develop.

TRLIA has completed Step 1 and initiated efforts on Steps 2 and 3 of the Goldfields Evaluation Work Plan. With the complementation of Steps 1 and 2 the RD 784 flood system will reliably provide 100-year flood protection to the urban area of RD 784.

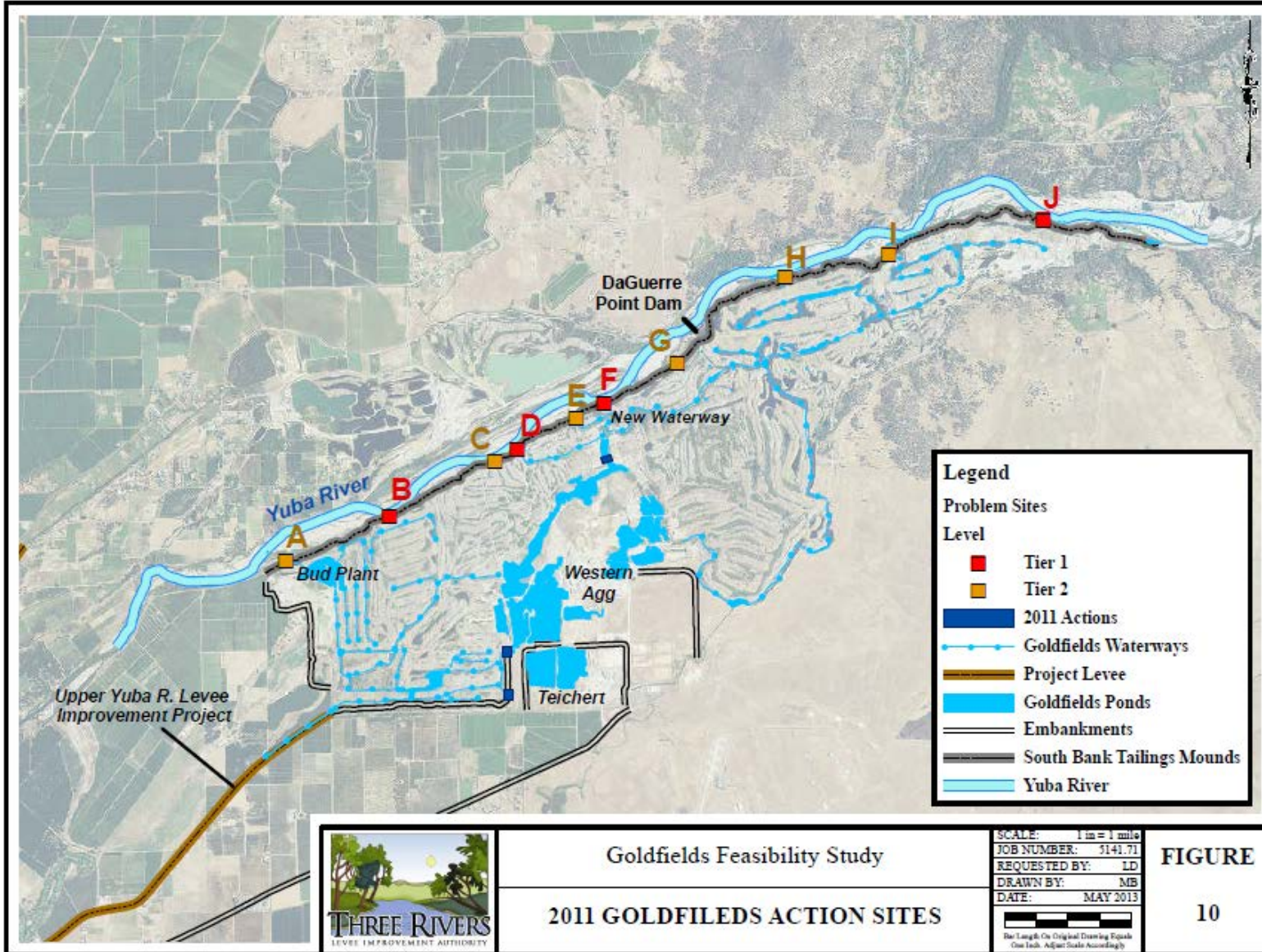


Figure 8-9. Goldfields Action Sites

8.1.4.2 Olivehurst Detention Basin

Background

The Western Pacific Interceptor Canal (WPIC) right bank levee protects the eastern side of RD 784. The upstream end of the WPIC levee terminated at a railroad embankment rather than high ground. This railroad embankment was relied upon for flood protection, but was never evaluated or certified as a flood control structure.

Construction of the SRFCP induced flooding in the area east and north of the WPIC. The Sacramento-San Joaquin Drainage District was supposed to have obtained flood easements for lands below elevation 59 feet (elevation of 1957 design profile in the project area) to mitigate for induced flooding. However, the State did not obtain all of the necessary easements in the project area and the SRFCP was flooding homes and business in South Olivehurst. USACE recognized this problem in the 1972 Bear River Feasibility Study and recommended construction of a new levee and pump station to protect Olivehurst and Linda. USACE's recommended plan would have eliminated the current portion of the WPIC levee that runs east-west and also reduced the current active floodplain, including lands on which the Sacramento-San Joaquin Drainage District has flood easement. USACE never constructed that project.

TRLIA Program of Improvements

TRLIA implemented a program of levee improvements to reduce the potential for flood damage in Reclamation District No. 784. The TRLIA Program included raising and strengthening the WPIC levee. The WPIC levee runs north-south along most of the alignment, but runs east-west at the upstream end crossing Highway 70 and tying into a railroad embankment. The WPIC levee west of Highway 70 had freeboard deficiencies and the railroad embankment could not be certified as a flood control structure. There were two alternatives to achieve the TRLIA project goals, correct the existing deficiencies with the SRFCP, and resolve flooding induced by the SRFCP.

Alternative 1 – Construct a new ring levee, pump station, and detention basin on Clark Lateral located on the WPIC right-bank levee just upstream of Highway 70 (See Figure 8-10). The ring levee is approximately 200 feet in length, tying the WPIC levee to Highway 70. This alternative would reduce the 1/100 AEP flood stage west of the ring levee to elevation 55.4 feet. This is approximately the elevation of the toe of the railroad embankment, avoiding the need for the railroad embankment to perform as a flood control structure and also eliminating the need to raise the WPIC levee west of the ring levee. This alternative is different and much smaller than the plan recommended by USACE in the 1972 Feasibility Study.

MBK performed a hydraulic analysis to evaluate the impact of the loss of floodplain storage on the surrounding area. USACE's Lower Feather River HEC-RAS model was used for this analysis. Removal of the project area from flood storage as a stand-alone project increases the water surface by 0.06 foot at the upstream end of the WPIC and attenuates to 0.00 foot at the Bear River. When evaluated in combination with the TRLIA's Bear River setback levee, there is a 0.82-foot reduction in flood stage at the upstream end of the WPIC. (Source Doc No. 2)

Alternative 2 – Raise the WPIC levee west of Highway 70, build a new levee adjacent to the railroad embankment, and purchase flowage easements. This alternative would require purchase of flowage easements on 15-30 parcels, most of which contain homes and business. The costs of the levee improvements would be incurred by TRLIA. The cost of the flowage easements and

associated relocation would need to be funded by the State because this is a liability of the existing SRFCP. Since there is not a State program to fund the flowage easements, a cost estimate for this alternative was not developed. It is anticipated that the costs would be much higher than Alternative 1.

Project Description

TRLIA constructed the Olivehurst Detention Basin (ODB) as evaluated in Alternative 1 above. Construction was completed in 2006 at a total cost of \$6.8 million. The project was funded through a \$4.7 million FEMA grant and \$2.1 million of local funding. The detention basin was also designed and constructed to serve as Giant Garter Snake (GGS) habitat. The GGS is an endangered species which has been sighted in the vicinity of the detention basin. The constructed habitat serves as mitigation for TRLIA construction impacts.

Technical Description – The ODB is a 23-acre facility that can store up to 250 acre-feet of interior run off. The ODB has been constructed as a system of low water channels and islands so that it can also serve as GGS habitat. The ring levee at the southeast corner of the ODB is 250 feet long and constructed at a minimum elevation of 62.2 feet National Geodetic Vertical Datum (NGVD) and a maximum elevation of 64.2 feet NGVD. This elevation provides 3 feet of freeboard to the 200-year flood event downstream of the ring levee in the WPIC. A pump station consisting of four, 44 cubic feet per second (cfs) pumps was constructed to pass interior runoff over the levee during the period of high water in the WPIC. A box culvert is in the ring levee to allow interior run off to pass through the levee when water surface elevations are low in the WPIC.

Conclusion

The Olivehurst Detention basin and Ring levee were constructed to mitigate the fact that the SRFCP levee on the right (west) bank of the WPIC terminated into a railroad embankment, not in to high ground. As a result, the SRFCP induced flooding in South Olivehurst. TRLIA, as part of its program to improve the levees in RD 784 to provide 200-year protection, constructed the ring levee and detention basin to mitigate this flooding and alleviate this system deficiency. **The ODB project should be incorporated into, and included in the SPFC and consideration should be given to incorporating these features into the Federally Authorized SRFCP, while the remnant east-west levee behind (eastward) of the detention basin needs to be removed.** In this way the federal and State authorizations will appropriately reflect the functional system, as it now exists.



Figure 8-10. Olivehurst Detention Basin - Alternative 1

Source: Google Earth, accessed 7/2/2013

8.1.5 Wheatland: Description of Ongoing, Planned, and Potential Actions

The City of Wheatland is located along Highway 65, between Dry Creek to the north and the Bear River to the south. Wheatland is considered an urbanizing area with a current population of approximately 4,000 residents expected to grow to over 12,000 in the next decade. The city sits mainly on a high ground ridge between Dry Creek and the Bear River, but many on the edges of town are susceptible to 100- and 200-year flooding and rely on the levee systems for protection (Figure 8-11). The levees are maintained by Reclamation Districts 2103 and 817. Wheatland sustained significant damage due to flooding along the Bear River in 1904. A levee break at the eastern end of the Dry Creek levee caused minor flooding in the December–January flood of 1997.

Reclamation District 2103 was created in 1964 to provide flood protection for Wheatland from flooding due to the Bear River and Dry Creek. It maintains the south levee of Dry Creek (there is no north levee upstream of Forty Mile Road) and the north levee along the Bear River from high ground east of Wheatland to the vicinity of Oakley Lane, which approximates the western extent of the urbanizing area. RD 817 is responsible for the maintenance of levees downstream

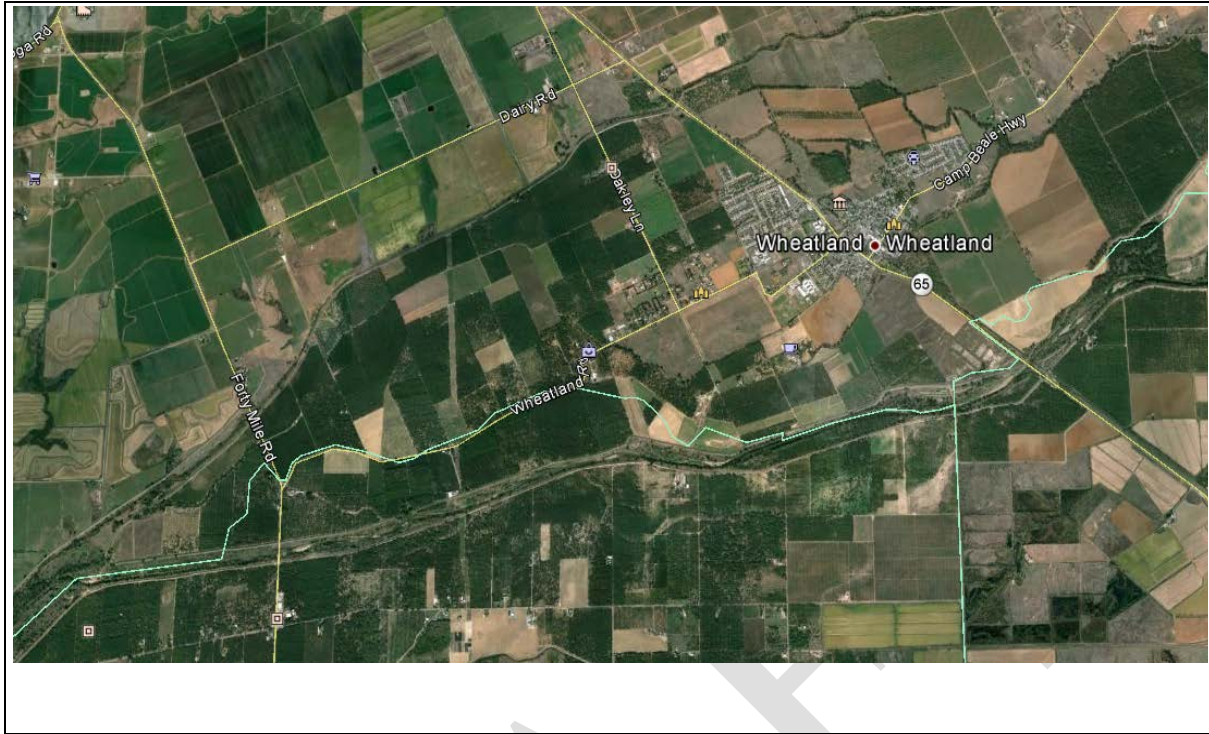


Figure 8-11. Wheatland General Area

of Oakley Lane as they extend westward to the confluence of the two streams, thus forming a pocket of largely rural-agricultural land. This area includes several homes and agricultural infrastructure. The land slopes downward generally in the westerly direction, and as a result, a levee failure in the RD 817 levee system, such as occurred in the 1930s, does not cause flooding in the City of Wheatland. RD 817 also maintains a short 1.3 mile stretch of the north levee of Dry Creek from just upstream of Forty-Mile Road downstream to the confluence with the Bear River, which also protects rural-agricultural lands.

The RD 2103 assessment area includes approximately 4,544 acres, but the levees maintained by the district protect another 2,200 acres in RD 817, for a total protected area of 6,744 acres. As shown in Figure 8-12, levee improvements were completed along the RD 2103 portion of the Bear River levee in 2007-09 and a levee assessment district was established by the district to fund operation and maintenance costs sufficient to meet FEMA 100-year standards (EPS 2010).

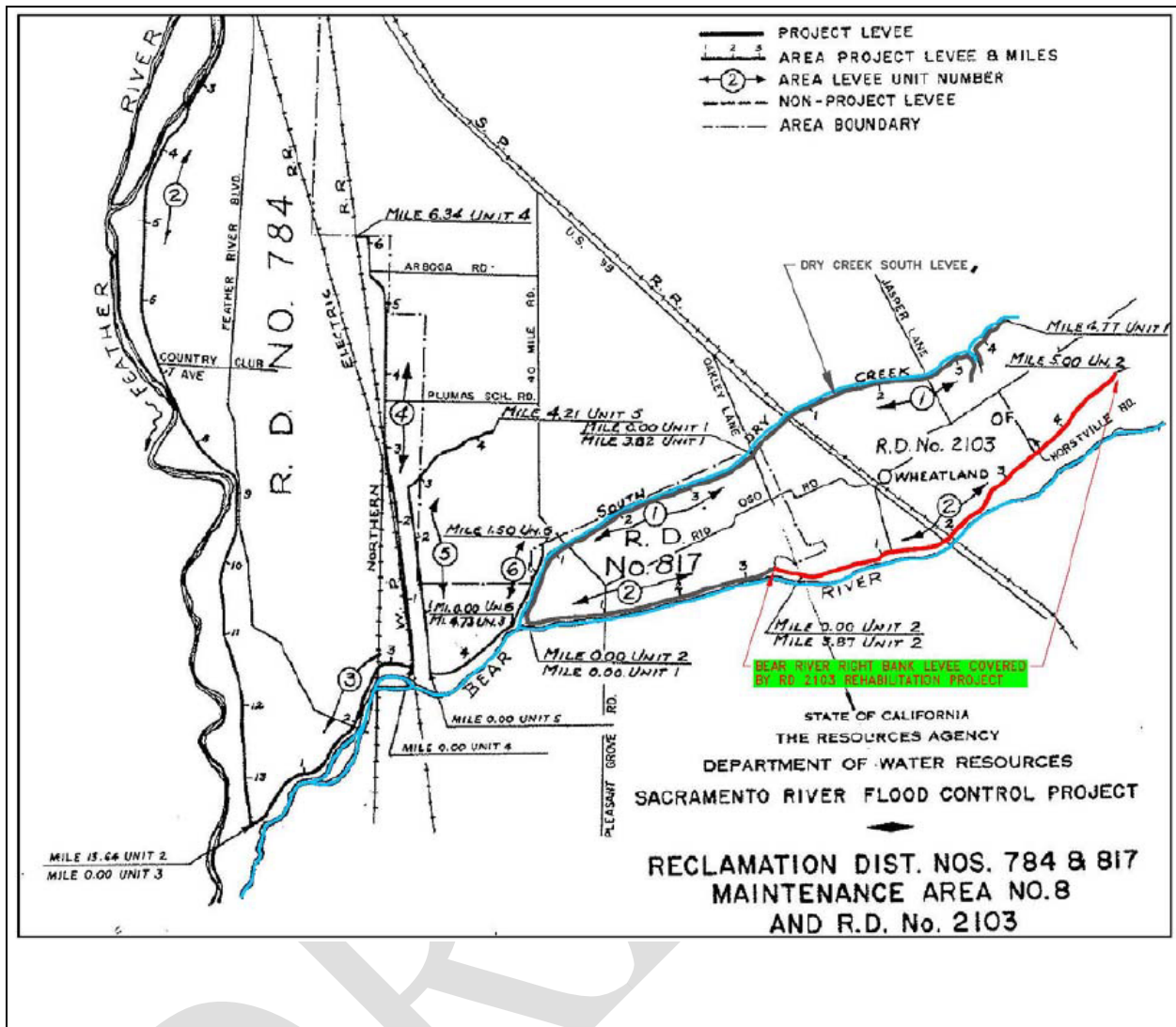


Figure 8-12. Wheatland Area Levees, including Recent Improvements
 Source: EPS, 2010.

With the completion of the Bear River levee improvements and the formation of this maintenance assessment district, this portion of RD 2103's levee system was certified and the southern portion of Wheatland along the Bear River was re-mapped by FEMA, effective February 22, 2011. Additional analysis and potential levee work will be required to comply with State ULDC requirements to ensure 200-year flood protection for Wheatland's urban and urbanizing areas from Bear River flooding.

In addition, the State Flood System Repair Program (FSRP) has preliminarily identified a critical reach of Bear River levee in RD 817 just downstream of Oakley Lane that will need to be protected from erosion or set back to meet current criteria. The site, located on the right (north) bank at Levee Mile 2.63 in RD 817 has been identified by DWR as a critical erosion site (LAN29, Best Slough - RD0817_02_0240_LM02.63). DWR issued a Notice of Eligibility (NOE) for funding through the Flood System Repair Project (FSRP) on December 11, 2013.

This reach of the Bear River levee system has a significant channel constriction between the north and south levees which increases channel velocities, leading to chronic bank and levee

erosion in this reach. The site nearly breached in the flood of February 1986 when scour caused a portion of the waterside levee embankment to slough. It was subsequently repaired by the Corps under PL 84-99, but continues to erode in high water events.

Through the *Pre-Feasibility Report, Leveed Area LAN29, Best Slough (URS, July 2013)*, DWR preliminarily recommended placing rock revetment along 1,200 feet of embankment to stabilize the levee during high water at an estimated cost of \$1,930,000. However, RD 817 and the adjacent property owner have proposed that the levee should be setback to remove the abrupt channel constriction. Although this alternative was preliminarily ruled out in the pre-feasibility study due to cost (\$7,800,000), DWR has agreed to work with RD 817 to further evaluate and implement the setback levee alternative as a multi-benefit project.

The RD 817 proposed setback levee is 2,400 feet long and would add approximately 9 acres to the floodway. This alternative is smaller than the alternative evaluated in the pre-feasibility study to avoid potentially significant utility and well relocation impacts to downstream property owners. RD 817 is currently processing a Letter of Intent to participate and expects that evaluations and design will begin in July 2014.

The northern portion of Wheatland remains at risk. Recent analyses suggest that previous estimates of Dry Creek flow frequency have substantially underestimated its potential for peak flood flows. Accordingly, Wheatland and RD 2103 will be evaluating what additional steps may need to be taken to ensure 100- and 200-year flood protection from Dry Creek flood flows.

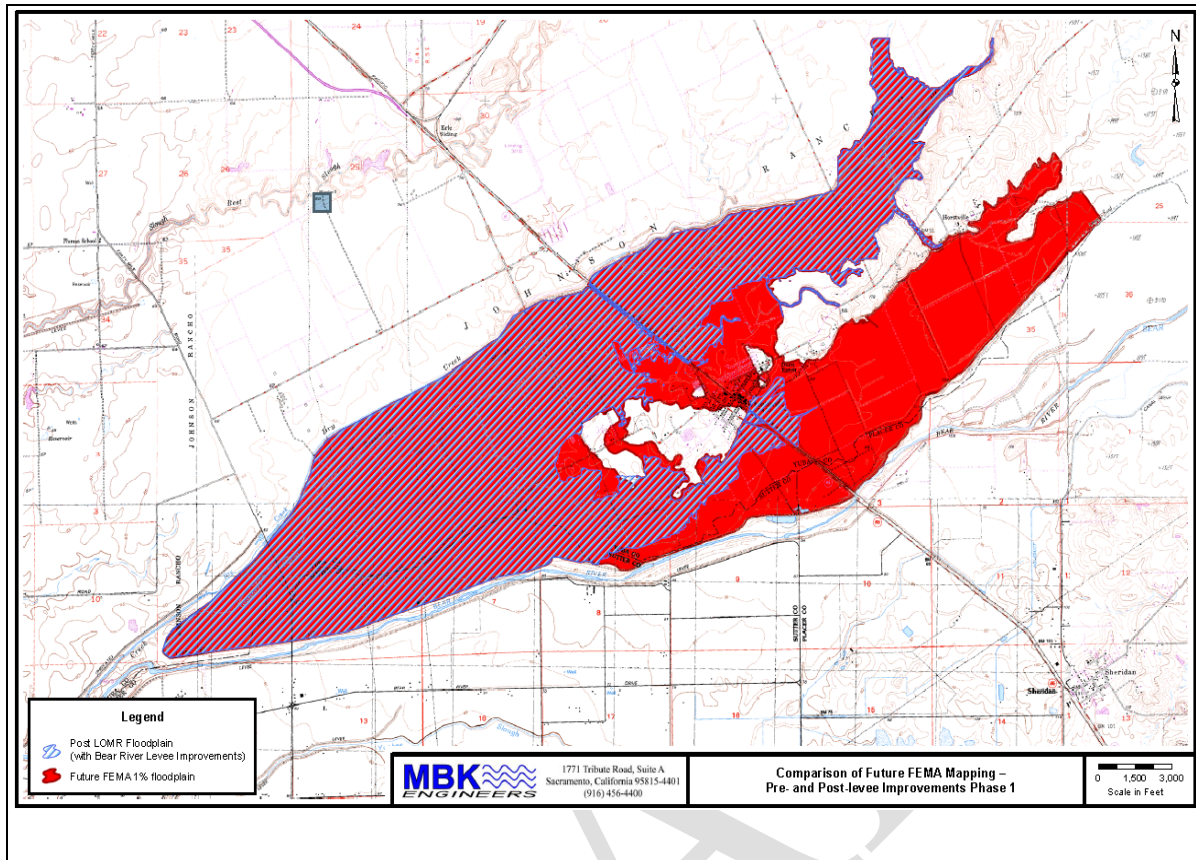


Figure 8-13. Wheatland 100-Year Flood Protection (in solid red)

Source: MBK, 2013.

The project levee along Dry Creek that protects Wheatland continues about 0.5 miles east of Jasper Lane, where the San Joaquin drain funnels floodwaters from Grasshopper Slough into Dry Creek. The Grasshopper Slough levee that diverts local drainage to Dry Creek through the San Joaquin Drain is not a project facility and thus cannot be relied upon in FEMA flood map delineation. The Dry Creek levee continues 0.8 miles east of the San Joaquin Drain, where it terminates at high ground. This easternmost levee provides minimal flood protection value, protecting approximately 60 acres of orchard from short-term inundation during flood events. This segment of the levee system is difficult to access and maintain. Removal of this levee would result in minor impacts on the orchard, but would restore floodplain connectivity, slightly attenuate flood flows, and reduce the District's O&M costs.

The levee along Dry Creek is generally three to eight feet in height. It was overtopped downstream of Jasper Lane in 1986 and was breached just upstream of Jasper Lane during the 1997 flood, which resulted in minor, localized flooding in the vicinity. During the December 31, 2005 to January 1, 2006 flood event the levee was nearly overtopped again and there were major boils requiring flood fights, this time in multiple reaches between 40 Mile Road and Jasper Lane. Recent analyses suggest that previous estimates of Dry Creek flow frequency have substantially underestimated its potential for peak flood flows. Prior to 2006 there were no flow gages along Dry Creek, and because the flow is unconstrained by levees to the north, it is difficult to accurately measure its peak flows.

Additional hydrologic, hydraulic, and engineering design studies will be required to determine what specific project actions will be required to provide flood protection from both Dry Creek and the remaining portions of the Bear River. Based on these studies, specific projects to achieve this level of flood protection will be proposed. The likely sequence of potential projects required to achieve and retain both FEMA 100-year flood protection and State 200-year flood protection ratings for the City of Wheatland and improve flood protection for the adjoining rural areas are shown in Table 8-6. The 100-year protection for Wheatland is shown in Figure 8-13..

Table 8-6. Wheatland (RD2103) Structural Flood Protection Improvements

ID	Description	Estimated Cost	Comments
L1	FSRP Identified Critical Repairs, Bear River north levee, RD 817	\$1.98 million	
L2	Dry Creek develop new hydrology	\$75,000	
L3	This is a feasibility study to evaluate 100 year alternatives for repairs on the southern portion of the Dry Creek Levee primarily protecting the city of Wheatland.	\$767,000	This project constitutes Phase 2 of RD 2103's goal of providing up to 200 year protection. Phase 1 included the design and repair of 5 miles on the Bear River North Levee south of Wheatland and was partially funded by DWR.
L4	Bear River north levee ULDC compliance evaluation.	\$400,000	Bear River North Levee Rehabilitation Project June 2010. Work completed, just need eval.
L5	Implement Dry Creek south levee 200-year ULDC levee improvements	\$25 million - \$75 million	Based on results of feasibility study
L6	Develop more accurate FEMA 100-year maps for the existing developed area that floods from Dry Creek	\$40,000	

8.1.6 RD 1001: Describe ongoing, planned, and potential actions

RD 1001 maintains 46 miles of levee that protect the small communities of Rio Oso, Nicolaus, East Nicolaus, and Verona, see Figure 8-14. The district protects a total population of 1,540 on 43,395 acres of largely rural-agricultural lands. The RD 1001 levee systems protect State Highways 65, 70, and 99, two active Union Pacific Railroad lines, two volunteer fire stations, two Pacific Gas and Electric substations and numerous transmission lines, both the Rio Oso and Nicolaus post offices, two grammar schools, both Nicolaus and Fairview cemeteries, the main drain pumping plant on the Natomas Cross Canal, three smaller drainage pumping facilities on Yankee Slough, and over a hundred miles of drainage canals. There is also significant agricultural infrastructure protected by the levee systems including two rice drying and storage facilities, five walnut processing and storage facilities, a fertilizer and pesticide distributor and warehouse facility, a feedlot, a dairy, several cattle ranches, and numerous hay and equipment storage barns and warehouses, see Figure 8-15. Although detailed estimates of property values

are not readily available, levee failure could result in significant damage to property and impact the local economy (RD 1001, 2013).

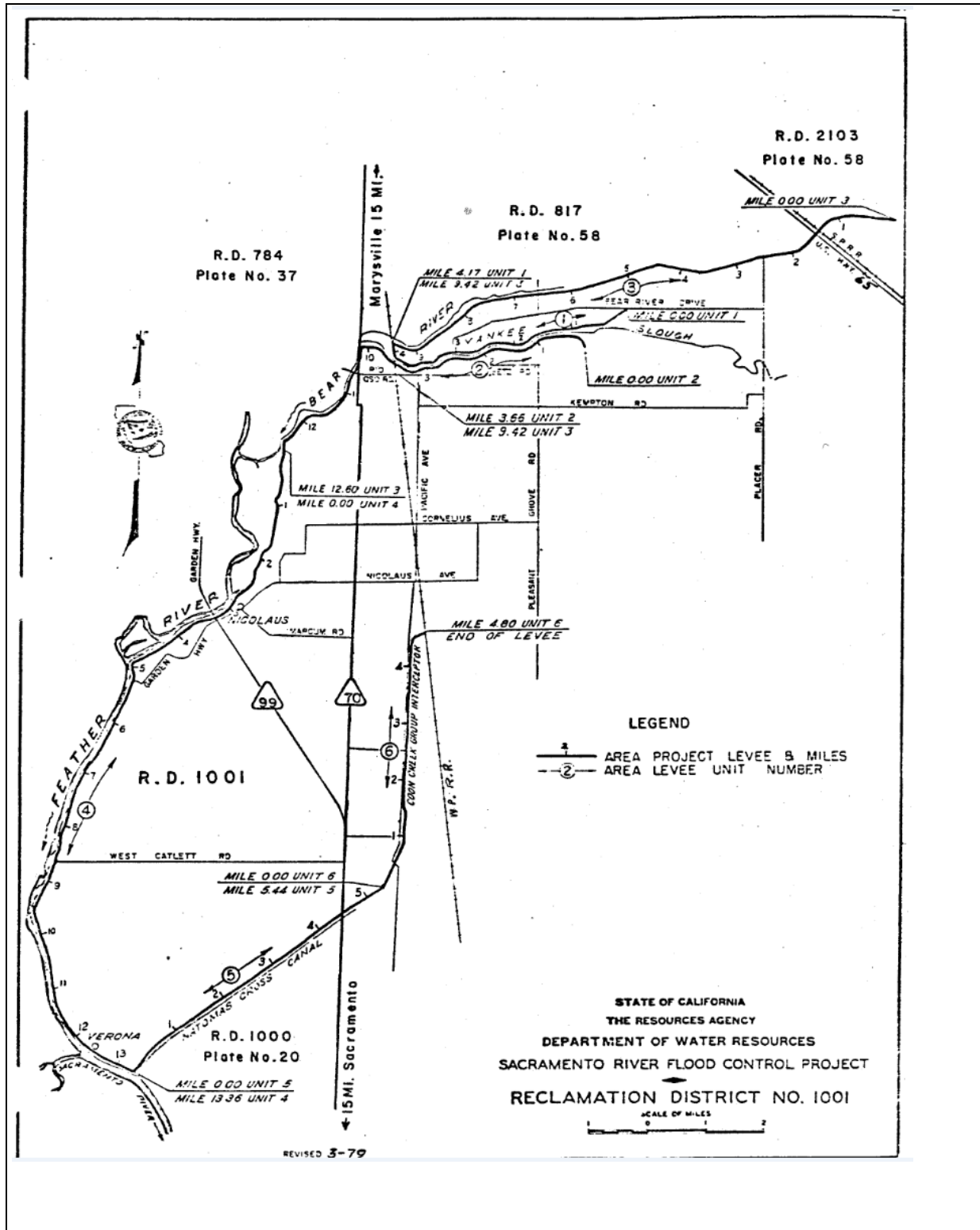


Figure 8-14. RD 1001 Boundary Map

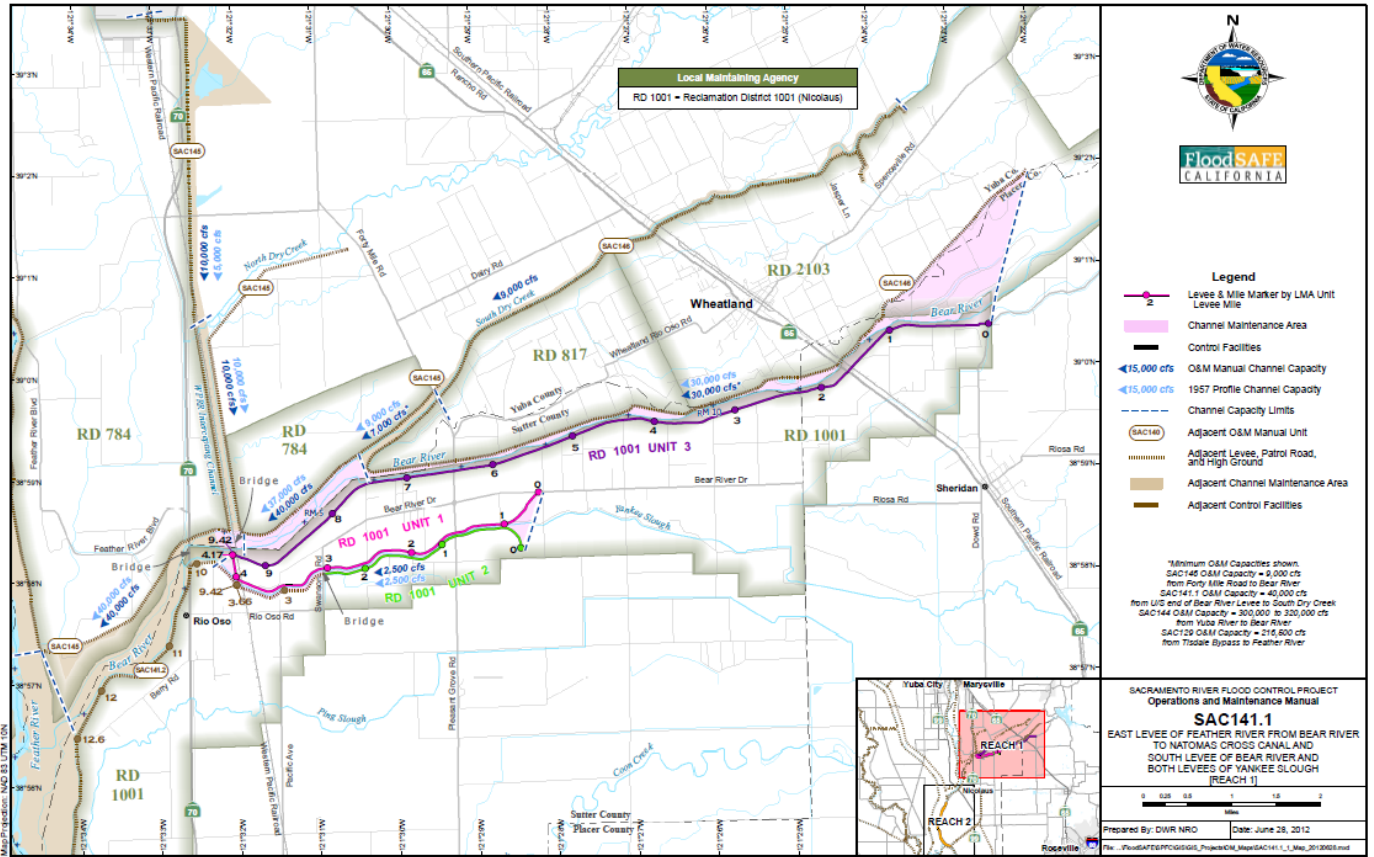


Figure 8-15. RD 1001 Levee System – Bear River and Yankee Slough

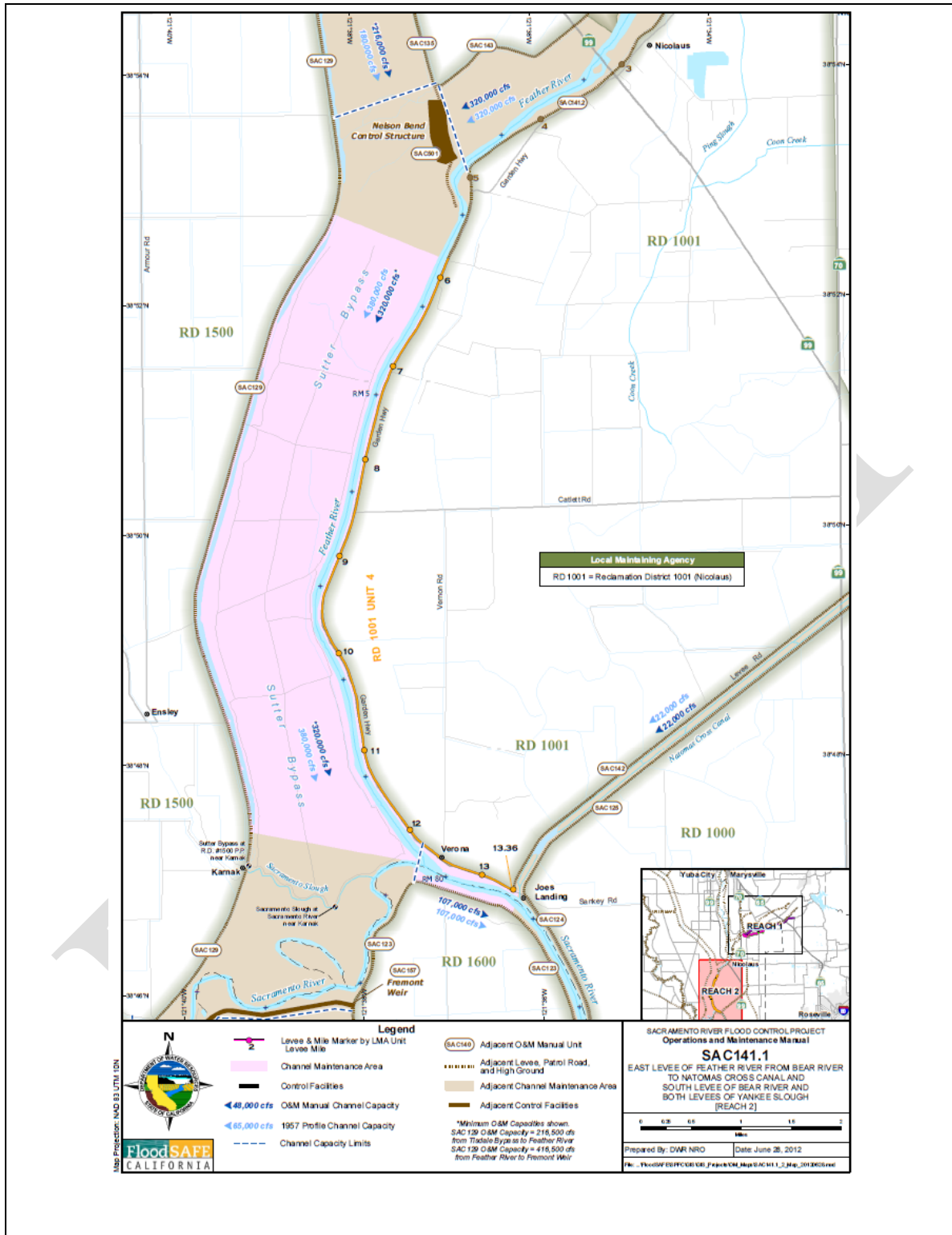


Figure 8-16. RD 1001 Levee System – Feather River and Natomas Cross Canal
 Source: DWR 1979

As described previously, the lands protected by RD 1001 levees were re-mapped as high-hazard areas with less than 100-year flood protection by FEMA in December 2008. Levee integrity problems include vegetation, encroachments, erosion, instability, seepage and underseepage, and rodents.

The district's annual budget is approximately \$622,000, funded through annual property assessments, agricultural leases on district-owned property, and revenues from sale of soil excavated from a district-owned borrow pit. The current budget barely covers annual operating expenses, which include five full-time staff, one part-time staff for administrative and book keeping support, and three seasonal employees; equipment; drainage pumping costs; chemicals; fuel; and other annual costs. The district does not have capital reserves to address major repairs or capital improvements at present. In 2008, Sutter County and the district negotiated an agreement with the Sacramento Area Flood Control Agency (SAFCA) to allocate up to \$9 million in future development fees raised by SAFCA for levee improvements for the district. Such development fees are linked to SAFCA's plan to restore its FEMA 100-year flood protection certification as it completes levee improvements for the Natomas Basin. These improvements have not yet been federally authorized (RD 1001, 2013).

Recently, the district initiated a Proposition 218 engineering study to evaluate the feasibility of establishing a new assessment to provide the local cost-share for future capital improvements. The district successfully passed with an 82% weighted approval on April 30, 2014 to raise an additional \$309,000 for improved maintenance and financing of \$5.4 million of critical repairs as identified by DWR in the Flood System Repair Program." at the end of para 3 starting with "Recently, the district..."

DWR and USACE inspections in 2012 identified numerous levee encroachments, erosion and caving, and vegetation concerns for the district's levee system. Based on operational experience, the most important district performance concerns include:

- Potential overtopping, recurrent wave wash erosion, slumps, and cracking of the Natomas Cross Canal north levee
- Integrity of the Feather River levee, from the Natomas Cross Canal upstream to the River Oaks Golf Course (Levee Unit 4, Levee Miles 5.2 to 13.4). Boils have been a concern in this reach during flood conditions and a failure along this levee reach would result in massive flows from the Feather River and the Sutter Bypass which can rapidly inundate the District.

The potential projects would:

- Raise, buttress, and provide erosion protection for the Natomas Cross Canal levee
- Address specific seepage, underseepage, erosion, and stability concerns for the Feather River levee, from the Natomas Cross Canal to the River Oaks Golf Course [Levee Unit 4, Levee Miles (LM) 5.2 to 13.4]. This would include filling the land side scour hole created when this levee was breached near Verona to drain flood waters in December 1955.
- Re-rock levee crown patrol roads
- Repair, replace, or abandon existing drains and pipes through the levees, many of which were installed as part of the system

- Improve erosion protection along the Bear River south levee
- Upgrade the Main Drain Pumping Plant, including replacement or raising plant to avoid sandbagging and providing backup power supply
- Construct a separate pumping plant on the Cross Canal at end of Lateral 4
- Phased improvements to the RD1001 levee system to achieve 100-year FEMA levee protection standards in the following sequence:
 - Natomas Cross Canal north levee
 - Feather River east levee, Cross Canal to River Oaks Golf Course
 - Feather River east levee, River Oaks Golf Course to Yankee Slough
 - Bear River south bank, Yankee Slough to Pleasant Grove Road
 - Yankee Slough north and south bank, from confluence to Pleasant Grove Road
 - Bear River south bank, Pleasant Grove Road to high ground
 - Coon Creek Group (Eastside) Interceptor Canal levee, Natomas Cross Canal to high ground
- RD 1001 supports channel conveyance improvements where consistent with the goals of the CVFPP. Such improvements could include better channel vegetation and sediment maintenance by the State, stabilization of banks in areas of high erosion, dredging of sediment and control or remove vegetation from the channel
- Expansion of the Yolo Bypass and lowering Fremont Weir, which could reduce stages in the southern portion of the region, in the lower Sutter Bypass and the lower Feather River would be of great benefit to RD1001. RD 1001 recognizes that any such expansion would need to be implemented in such a way that local concerns and interests would be fully addressed.
- Removal of Nelson Weir on the Feather River right bank at its confluence with the Sutter Bypass, to reduce erosion and improve habitat values
- Consistent with the CVFPP, RD 1001 seeks a streamlined permitting process to facilitate herbicide application and other routine maintenance activities for levees and drainage facilities

These levee, drainage, and environmental improvement options are summarized in Table 8-7.

State cost sharing for such repairs could potentially be obtained through the DWR Flood System Repairs Program (FSRP) and/or other programs as identified. Such repairs could be designed to achieve multiple benefits, and thereby qualify for more favorable State cost sharing contributions.

Table 8-7. RD 1001 Structural Flood Protection Improvements

ID	Description	Estimated Cost	Comments
L1	Address specific seepage, underseepage, erosion, and stability concerns for the Feather River	\$5.4 M	50% of 8.2 miles of seepage berm; seepage berm 80' x 4' w/collection pipe

	levee, from the Natomas Cross Canal to the River Oaks Golf Course (Levee Unit 4, Levee Miles 5.2 to 13.4) and repairs to the Natomas Cross Canal downstream of Highway 99.		
L2	Re-rock levee crown patrol roads	\$1.5 M	AB for 75% of levees in district
L3	Repair, replace, or abandon existing drains and pipes through the levees	\$86,680	Replacement and repair expected to be completed by farmer. District would only abandon. Grouting 2/mile. 14" pipe 70' total length. Assumed 10' below WSE
L4	Improve erosion protection along the Bear River south levee	\$2.6 M	12.6 mi. total. 50% erosion protection 2' thick
L5	Upgrade the Main Drain Pumping Plant	\$500,000	Assumption for whole project?
L6	Construct a replacement pumping plant on the Cross Canal at end of Lateral 4	\$500,000	Assumption for whole project?
L7	Phased improvements to the RD1001 levee system to achieve 100-year FEMA levee protection		
L7A	<ul style="list-style-type: none"> Natomas Cross Canal north levee 	\$123.9 M*	Use NULE RACER Segment 284
L7B	<ul style="list-style-type: none"> Feather River east levee, Cross Canal to River Oaks Golf Course 	\$349.8 M*	NULE RACER Segment 247
L7C	<ul style="list-style-type: none"> Bear River south bank, Yankee Slough to Pleasant Grove Road 	\$75.2 M*	NULE RACER Segment 283
L7D	<ul style="list-style-type: none"> Yankee Slough north and south bank, from confluence to Pleasant Grove Road 	\$57.6 M*	NULE RACER Segments 144, 145
L7E	<ul style="list-style-type: none"> Bear River south bank, Pleasant Grove Road to high ground 	\$109.7 M*	NULE RACER Segment 246
L7F	<ul style="list-style-type: none"> Coon Creek Group Interceptor Canal levee, Natomas Cross Canal to high ground 	\$13.5 M*	NULE RACER Segment 285

¹ Due to potential effects on stages upstream of Fremont Weir, in the lower Sutter Bypass and the Feather River
* Estimates from North NULE Study Area Remedial Alternatives and Cost Estimates Report (RACER)

8.1.7 Channels: Options for Improved Management and Function

8.1.7.1 Feather River Corridor Management Plan

This entire reach of the LFRC extending downstream of State Route 20 for approximately 21 miles to the Sutter Bypass near Nelson Slough, inclusive of the downstream components of the Yuba and Bear rivers downstream and westerly of their respective State Route 70 bridge crossings is included in the LFRCMP. The greatest opportunities for ongoing and future native habitat restoration activities in the LFRCMP for the reach between the Yuba River and the Bear River exist within the setback areas created by the Star Bend Setback Levee on the Feather River, the Bear River Setback Levee constructed by TRLIA, and the small setback levee area at Star Bend constructed by Levee District One of Sutter County. Other opportunities for improved vegetation and channel management exist at Eliza Bend, Abbott Lakes, O'Conner Lakes, the Lake of the Woods Wildlife Area, and near the confluence of the Feather River with the Bear River. This multi-year, multi-agency collaboration is expected to be completed in Summer 2014. The current draft appears to have similar findings for extensive ecosystem restoration opportunities within the existing floodway as the RFMP to accomplish wildlife habitat restoration goals while preserving agricultural lands and productivity in adjacent areas.

8.1.7.2 Sacramento Valley IRWMP

The Sacramento Valley Integrated Regional Water Management Plan (IRWMP) is being developed to provide a framework and forum to guide the development of water resources policies, programs, and projects to meet the objectives described in Section 2, Sacramento Valley IRWMP Objectives. This IRWMP builds on many years of ongoing regional and sub-regional planning and related project development and implementation. The Sacramento Valley IRWMP is intended to improve coordination and the sharing of ideas across the Sacramento Valley IRWMP Region to allow for improved water management at the local, regional, and state level. This IRWMP will serve as a regional planning process that is consistent with the DWR Bulletin 160, (California Water Plan) and the State Water Resources Control Board's (SWRCB) Strategic Plan, its Watershed Management Initiative, and the basin planning process.

The Sacramento Valley IRWMP is described as a grassroots planning process that will help implement the state's strategy to place "more emphasis on integrated regional water management" by building on regional-level water management strategies and then integrating these strategies into a coherent super-regional water management plan. Yuba County IRWMP water users in Yuba County have worked together for years to develop an integrated regional approach to water and flood plain management. Local, State, and federal agencies have been working together to achieve consensus and resolved water supply conflict through the development of the Lower Yuba River Accord. From a flood control perspective, the local agencies have worked with State and federal agencies to implement integrated approaches to flood control and flood plain management. The Yuba County Integrated Regional Water Management Plan (IRWM Plan) builds upon this local and regional cooperation to resolve issues and integrate water supply, flood control, and ecosystem management activities.

Despite the extensive efforts invested in the IRWMP process, flood risk reduction projects have not been fully integrated, and in fact have moved forward towards implementation on separate tracks. In order to achieve the potential benefits of full integration it will be important to recognize the unique and critically important public safety benefits associated with flood risk reduction projects.

8.1.8 System Transitory Storage

The region has explored alternatives for reducing peak flood stages through the use of transitory floodplain storage along Dry Creek and the Bear River in the vicinity of Wheatland (MBK, 2013). Potential beneficiaries could include reclamation districts 2103, 1001, 817, and 784. The potential transitory storage locations evaluated included agricultural areas upstream of Wheatland along Dry Creek and the Horseshoe area, in the vicinity of the Bear River-Dry Creek confluence. System hydraulic modeling suggested that up to 6500 acre-feet of storage could be activated, with a maximum stage reduction of about 0.9 feet in the vicinity of the proposed levee overflow weir near 40-Mile road. This work was preliminary and does not suggest that local property owners are supportive of this concept. Any proposal to create transitory storage in these areas would need the support of affected property owners and local governments, with appropriate compensation for changes in land use and frequency of flooding.

8.1.9 Reservoirs: Options for structural improvements and improved operations

8.1.9.1 Flood-Coordinated Operations (F-CO)

As noted in Chapter 4, F-CO has been an ongoing effort, intensified since 2005, to jointly operate Lake Oroville and New Bullards Bar reservoirs to meet downstream flow objectives and minimize the risk of flooding. Continuing improvements in flood modeling tools, risk evaluation tools, real-time information, and flood forecasts would be implemented under F-CO.

8.1.9.2 Forecast-Based Operations (F-BO)

F-BO involves altering the reservoir operating rules and regulations to take into consideration forecasts of future reservoir inflow, rather than considering only the current watershed condition, reservoir storage, and reservoir rate of rise criteria. By taking into consideration forecasts of future inflow, it is possible to make anticipatory releases in advance of major flood peaks to take maximum advantage of downstream channel capacities, thus reducing the risks of flooding downstream. Such anticipatory releases are not without a down side, however. They can cause life safety concerns downstream, cause erosion and other forms of levee damage, and the loss of water supply and electrical generation benefits in the event that the anticipated flood inflows do not materialize as forecast. Careful implementation of F-BO can avoid these complications. Clearly, the extent to which the benefits of F-BO outweigh the safety and economic risks hinges on the quality of the inflow forecasts.

F-BO can also potentially enhance water supply and power generation benefits by allowing reservoir operators to reserve less flood control space than would otherwise be the case. Such additional stored water would be released to clear sufficient flood control storage to contain the anticipated storm inflows.

The science and technology of weather and hydrologic forecasting has been steadily improving with advances in computing capacity, modeling tools, hydrologic data collection, and flood operations experience. For example, Andrew Smith (2009), stated,

“The two-day forecast of today is as accurate as the one-day forecast was in 1988. The seven-day forecast now is as accurate as the five-day forecast was then. Extreme-weather forecasts have improved even more over the same period. People who once received on average five minutes' warning before a tornado - and no warning at all 74

percent of the time - now get 13 minutes' warning on average, and receive some warning 69 percent of the time. Flash flood forecasts now come, on average, more than an hour before the floods themselves. Much of the improvement comes from a new generation of radar that went into service in the early 1990s. Unlike older radar technology, which basically bounced off storms, today's Doppler radar units can peer through fronts and measure things such as wind speed."

Therefore, F-BO can potentially offer a way to make more effective use of existing facilities for multiple benefits, including flood protection, water supply, and power generation.

Figure 8-17 illustrates the concept of F-BO, as applied to operation of Oroville Dam and Reservoir, with a simulated 200-year flood and an assumed forecast lead time of 72 hours. The figure suggests that F-BO can provide modest, but significant reductions in downstream peak flood flows.

Adequate release capacity is the fundamental structural requirement for aggressive management of reservoir storage. Therefore additional release capacity may be considered a companion structural option for both F-CO and F-BO.

8.1.9.3 Structural Improvements for Oroville Dam and Reservoir

As noted in Chapter 4, the unlined emergency spillway for Oroville Dam would likely suffer heavy damage in the event it must be used in a major flood event. Erosion of the hillside would also release large amounts of soil and rock into the channel downstream, with potential impacts on downstream channel capacity and environmental quality. Therefore, erosion protection for this hillside may be considered a long-term investment in the integrity and environmental quality of the channel system downstream of the dam. By eliminating this operational concern, there is a greater likelihood that DWR would elect to surcharge the reservoir rather than exceed the 150,000 cfs objective release during major flood events, such as occurred during the 1997 New Year's Flood.

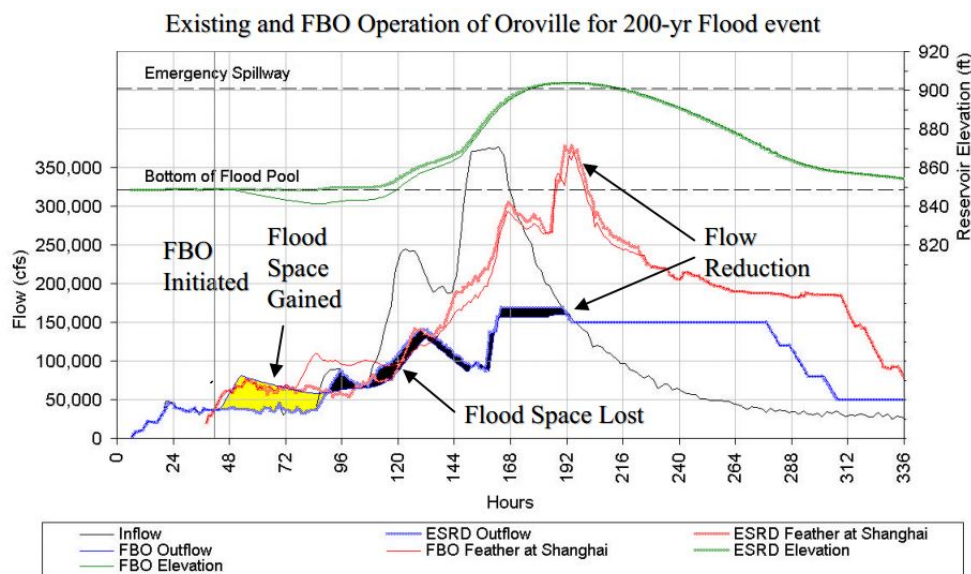


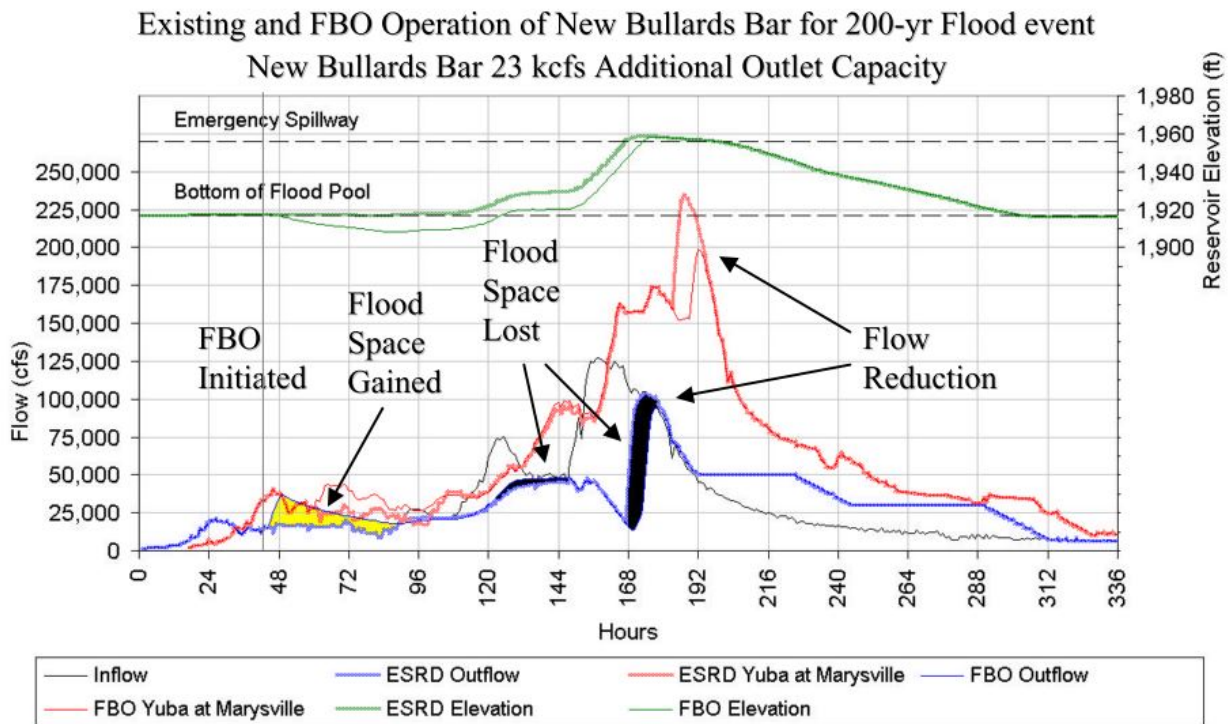
Figure 8-17. F-BO for Oroville Dam and Reservoir, 200-Year Flood, 72-Hour Lead Time
Source: MBK, 2002

8.1.9.4 Structural Improvements for New Bullards Bar Dam and Reservoir

Yuba County Water Agency has analyzed alternatives for improving the flood operation efficiency at New Bullards Bar Reservoir by increasing its capability to make flood releases at lower reservoir stages. This increased efficiency would result in smaller flood flow peaks downstream for moderate to large flood events.

YCWA has examined several ways to increase the flood release capacity. The most cost effective and efficient method was to add a second gated spillway tunnel to the outlet works. The additional spillway which was analyzed in the operation consisted of three 17-foot wide by 30-foot high gated openings set at an invert elevation of 1,870 feet. The addition of the new outlet structure would increase the reservoir release capacity by 45,000 cfs when the reservoir is not encroached at the bottom of the flood pool elevation at 1918 feet. This increases the release capacity at this elevation from the present 19,000 cfs to 64,000 cfs.

To optimize the use of both F-CO and F-BO it is necessary to have adequate release capacity at reservoir stages lower than the bottom of the flood pool (elevation 1918 feet). At that stage, only about 19,000 cfs can currently be released over the spillway crest (elevation 1902 feet). An additional 45,000 cfs would greatly improve the effectiveness of New Bullards Bar Dam and Reservoir. Figure 8-18 provides an example of how F-BO operations can reduce downstream peak flood flows, in this case, combined with an additional 23,000 cfs release capacity on downstream flows with a 200-year flood event. As shown, the peak downstream flow for the Yuba River at Marysville was reduced from about 240,000 cfs to 200,000 cfs with these improvements. Results would be significantly better with the full 45,000 cfs increase.



Source: MBK, 2002

Figure 8-18. Example of F-BO for New Bullards Bar Dam and Reservoir combined with New Outlet Works of 23,000 cfs Capacity, 200-Year Flood, 72-Hour Lead Time.

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9 Residual Risk Management Alternatives

The leveed channels, multipurpose reservoirs, and other structures which now comprise the flood control system have greatly reduced the chance of flooding and made possible the vibrant communities and agricultural development of floodplains in the Feather River Region. 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.” This residual flood risk can be managed and further reduced over time through a number of measures. These include enhanced emergency response, enhanced operations and maintenance (O&M), and floodplain management actions. Generally speaking, areas protected by levees that receive major improvements will require lower levels of residual risk management compared with levees that are not improved.

Some of the risk management measures can be implemented at the local and regional levels; others require State and federal actions as well. Below is a brief description of some of the most important options to effectively manage the risks.

9.1 Enhanced Flood Emergency Response

9.1.1 Purpose

The primary purpose of enhanced flood emergency response is to prepare for floods, effectively respond to flood events, and quickly recover when flooding occurs thus minimizing their impacts. This is particularly true for rural-agricultural areas where physical improvements are not likely to be as extensive as in more populated areas. Enhanced flood emergency response includes providing flood hazard information, real-time flood data, more frequent and timely flood forecasts, and state-of-the-art flood emergency information dissemination.

9.1.2 Financial Aid

FEMA and DWR both provide grants to assist local agencies in improving flood emergency preparedness. Under the Disaster Mitigation Act of 2000, FEMA has provided both financial support and regulatory encouragement by requiring that local communities prepare hazard mitigation plans in order to remain eligible for FEMA disaster assistance. All of the counties in the region have prepared such hazard mitigation plans, considering a wide range of hazards, including flooding.

Local agencies can participate in a one-time State-local cost-shared program to implement enhanced flood emergency response actions. In July 2013, DWR announced the tentative distribution of \$10 million in emergency preparedness grants, pending public review and comment. Preliminary funding allocations for regional agencies are summarized in Table 9-1.

Table 9-1. Regional Agencies Recommended for Funding, Flood Emergency Response – Statewide Grants, July 2013

Lead Agency	Amount Recommended
Sutter Butte Flood Control Agency	\$416,469
Yuba County	\$123,500
Reclamation District 784 ¹	\$284,519
Yuba City Fire Department	\$111,289

¹The RD 784 grant is for a flood fight coalition that includes LD1, RDs 10, 784, 817, 1001, and 2103, and the Marysville Levee District.

Source: DWR, 2013

9.1.3 Coordination

Coordinated flood operations among local maintaining agencies, cities and counties in the region, the Governor’s Office of Emergency Services, the State-Federal Flood Operation Center, USACE, the CDFW Office of Spill Prevention and Response (OSPR) are critically important in managing and fighting floods, saving lives and properties, and limiting the spread and impact of toxic materials in floodwaters. DWR will support such coordinated flood operations by improving access to both real-time hydrologic information and system descriptive data such as maps, as-built drawings, operations and maintenance manuals, levee logs, permits, channel capacities, easements, real-time flood data and forecasts, and flood models. In addition, through the State-Federal Flood Operations Center, DWR will continue to provide floodfight assistance such as technical assistance, flood emergency response teams, and materials when the local resources are exhausted.

9.1.4 Status of Regional Flood Emergency Response Planning

Local agencies in the Feather River region can take many actions to improve local flood emergency response capabilities, including preparing flood emergency response plans, developing appropriate regional communications tools and processes for emergency response operations, stockpiling strategically-located resources for floodfight activities, and conducting training exercises.

Traditionally the counties (known under SEMS as Operational Areas) have not included LMAs in planning or exercises. LMAs have relied primarily on DWR as their primary flood fight trainer, resources provider, and the next link in the SEMS chain of command rather than the local Operational Areas (OA) management structure. This duality has created some confusion.

The full benefits of the current LMA structure for levee emergency response and management cannot be realized without cooperatively addressing the staff and financial limitations of LMAs and related jurisdictional issues that prevent more effective, decentralized response to levee problems in a major valley-wide event, placing additional response burdens on State and Federal agencies for flood fighting (CVFCA, 2013). Since most LMA elected officials are unpaid and LMA staffs very small, advanced notice of training or exercises is required to facilitate LMA participation.

Under the FEMA DMA planning process, the counties in the region have created good Emergency Operations Plans. The flood hazard information in their plans is detailed and

appropriate, although there are concerns that the risks due to high water in the Sutter Bypass and Sacramento River have not been fully characterized and addressed. Hazard mitigation plans, which include flood hazards, either are current or are being updated under FEMA's 5-year requirement. These plans include actions by LMAs.

Flood response training varies widely, but regional jurisdictions attend DWR Flood Fight Training at least biennially. For the past six years, RD 784 has regionally hosted DWR's class on Flood Fight Methods. YCWA hosts periodic meetings in which emergency preparedness may be a topic.

Cal EMA has no training for Emergency Operations Center (EOC), so at least one OA is developing its own. However, even at the OA level, there has been a significant reduction in funding available for emergency management, especially for training.

Cities in the region have far fewer emergency management resources than the counties. In some cases, the county has full responsibility for the city's emergency preparedness. Emergency coordinator positions are generally ancillary to regular duties in police or fire. Due to insufficient funding and staffing for the emergency coordinator role, there is little formal emergency management training and minimal participation in DWR pre-season training. City hazard mitigation plans are generally incorporated into the respective County plan. Thus there are significant opportunities to improve upon current plans.

The LMAs are principally focused on levee maintenance, high water patrols, and when necessary, flood fights at threatened sites. During high water events, LMAs follow their Operations and Maintenance Plan requirements for levee monitoring and deploying patrols. They are generally underfunded, with few staff or funding for other emergency preparedness and response activities. While some have planning documents, these are often out-of-date and there are no scheduled updates. However, LD 1 in Sutter has used the guidance provided by DWR under AB 156 to document its proposed emergency response plans.

Under the leadership of RD 784 (Plumas Lakes), the Yuba-Sutter Flood Fight Coalition – consisting of MLD, LD 1(S), RD 10, RD 784, RD 817, RD 1001, and RD 2103 – was formed and is now developing formal arrangements to improve training, communications, and other emergency response capabilities. The Yuba-Sutter Flood Fight Coalition has worked to reinforce the LMAs' primary responsibility as part of the Operational Area (with a secondary responsibility to inform DWR).

Some stockpiles of flood fight materials exist, sufficient for two days or less. In effect, LMAs are reliant on DWR for flood fight materials to provide additional materials such as sandbags, poly-sheeting, stakes, twine, hand tools, and other materials. The Coalition is developing formal arrangements to store and share flood fight materials.

9.1.5 Emergency Preparedness Options for Improvement

1. Half-day coordination meetings could be conducted with DWR and all emergency managers in the Feather River Basin. The principal objective would be to develop a better understanding of issues faced by local emergency officials. Such meetings would be a logical extension of the periodic meetings conducted by the Yuba County Water Agency. Estimated annual cost: \$12,000 - \$15,000.

2. A short tabletop exercise might be added to DWR’s annual pre-season flood fight training. The principal objective would be to develop a mutual understanding of regional issues and potential responses. Estimated annual cost: \$20,000 - \$25,000.
3. DWR may wish expedite development of Area-Specific emergency plans for levees under its responsibility. These plans should be coordinated closely with the Operational Area(s), nearby communities, and LMAs. Estimated cost: \$50,000 - \$60,000.
4. Support should be provided to the development of formal Mutual Aid Agreements regarding storage and sharing of flood fight materials. This support should include funding for purchasing and storing supplies for regional flood fight activities. The stockpiling of such shared supplies does not relieve individual LMAs of the responsibility to maintain adequate supplies of flood fight materials as required under the DWR levee inspection program—shared supplies provide are intended to provide an added level of redundancy, flexibility, and resiliency to regional flood preparedness rather than a replacement for individual LMA supplies. The efforts of the Yuba-Sutter Flood Fight Coalition should be supported, expanded, and replicated. Estimated cost: \$55,000 - \$60,000.
5. Development or updating of emergency plans and flood-specific checklists by cities and LMAs should be encouraged and supported. Estimated cost: \$100,000 - \$200,000.

Table 9-2 below summarizes this section.

Table 9-2. Summary of Emergency Preparedness Options

	Options for Improvement	Estimated Cost (\$)	DWR (@\$75/hr)	Consultant (@\$100/hr)	Comments
1	Half-day coordination meeting could be conducted with DWR and all emergency managers in the Feather River Basin. The principal objective would be to develop a better understanding of issues faced by local emergency officials. Such meetings would be a logic extension of the periodic meetings conducted by the Yuba County Water Agency.	\$12,000	\$4,000	\$8,000	Annual costs for prep (8 hrs), meeting (4 hrs), & follow-up (4 hrs) for 4 meetings.
2	A short Tabletop exercise might be added to DWR’s annual pre-season flood fight training. The principal objective would be to develop a mutual understanding of regional issues and potential responses.	\$20,000	\$4,000	\$16,000	Annual costs for prep (80 hrs) TTX (2 hrs), & follow-up (8 hrs).
3	DWR may wish to expedite development of Area-Specific Emergency Plans for levees under its responsibility. These	\$52,500	\$22,500	\$30,000	100 hrs for each Maint. Area for DWR & Consultants.

	plans should be coordinated closely with the Operational Area(s), nearby communities, and LMAs.				
4	Support should be provided to the development of formal Mutual Aid Agreements regarding storage and sharing of flood fight materials. This support should include funding for purchasing and storing supplies for regional flood fight activities. The efforts of the Yuba-Sutter Flood Fight Coalition should be supported, expanded, and replicated.	\$55,000	\$5,000	\$50,000	These estimates may be low, depending on the amount of attorney times involved.
5	Development or updating of emergency plans and flood-specific checklists by cities and LMAs should be encouraged and supported.	\$105,000	\$5,000	\$100,000	DWR time is for plan review.

9.2 Enhanced Flood System Operations and Maintenance

Enhanced Flood System Operations and Maintenance (EFSOM) includes work to keep regional flood management facilities in good condition so they continue to function as designed. EFSOM activities include channel maintenance such as hydraulic assessments, sediment removal, channel clearing, and vegetation management); erosion and levee repairs; levee inspection, evaluation, and maintenance; and repair and replacement of hydraulic structures.

Currently, operations and maintenance responsibilities within the flood management system are fragmented and often underfunded. Funding has been insufficient to keep pace with the rapidly rising cost of routine maintenance, which has been escalating due to rising costs of labor, fuel, equipment, chemicals, insurance, and engineering support. In addition, permitting constraints and requirements have added administrative costs, field maintenance costs, and limited the periods during which maintenance can be carried out.

Some cost savings can be achieved through consolidation of reclamation districts through the efficiencies of scale and consolidation of administration, equipment, and maintenance functions. However, consolidation of historically independent districts, with varying legal descriptions, authorities, funding sources and levels, labor arrangements, retirement liabilities, Proposition 218 restrictions, and other unforeseen obstacles can be a difficult and complex undertaking. Any future consolidation effort should be based on local interest and support, a detailed understanding of the complexities involved, and open communication with affected property owners and residents. Voluntary collaboration among adjacent districts may provide a first step in the consolidation process.

Voluntary collaboration is also important in flood corridor management, where DWR has primary maintenance responsibility, CDFW and other resources agencies have permitting and

oversight responsibilities, and underlying property ownerships may involve private parties. It is important that the interests of all affected parties be communicated and understood such that management activities can be as effective as possible while minimizing impacts and conflicts.

Updating and clearly delineating the boundaries of reclamation districts, State-owned and managed lands, and lands with various easement restrictions can help improve efficiency and coordination.

Maintenance activities involve earthmoving, mowing, and spraying equipment from place to place. Such activities can help spread invasive species, which are difficult and expensive to eradicate and cause great environmental harm. Such equipment can also cause inadvertent harm to floodplain habitats. It is therefore important to plan staging of equipment and execution of the work with such potential impacts in mind.

Similarly, the region may consider supporting consolidation and expansion of State maintenance responsibilities for the system of weirs and bypass channels that comprise the backbone of the SRFCP.

Regional efforts to streamline permitting through flood corridor management planning offer the potential for reducing costs for individual reclamation districts.

In some cases, O&M can be improved to achieve greater efficiency, improve environmental compliance, and lower costs through the implementation of Best Management Practices.

Establishing adequate and stable funding for maintenance will be essential to the long-term success of EFSOM.

Some of the activities may require legislative action, new institutional arrangements involving local maintaining agencies, modifications to existing State programs, and additional revenue generation.

Regional agencies may consider working with DWR and USACE to develop a coordinated partnership program to conduct regular erosion repairs on the waterside of the project levees in the region to promote efficient and timely repairs. Since 1960, DWR and USACE have jointly implemented the Sacramento River Bank Protection Project, designed to address erosion throughout the system. While this project has served the SRFCP well, repairs are often deferred until they are critical, and thus very expensive to execute. A more proactive approach may offer significant cost saving opportunities for the future.

All weather access for patrols and flood fighting is of critical importance for regional levees, particularly in those areas where levees have not been improved to current engineering standards. Accordingly, maintaining all-weather access roads along levee crowns, and where possible, along land side levee toes, are high priorities for enhanced flood system operations and maintenance.

9.3 Floodplain Risk Management

9.3.1 National Flood Insurance Program Refinement for Rural-Agricultural Areas

Regional agencies and communities may take advantage of federal and State risk mitigation actions, such as flood proofing and elevating residential and nonresidential structures. Where such flood risk reductions are not feasible, federal and State funds for relocating, selling, or demolishing at-risk structures may be available.

Senate Bill 5 and related legislation passed in 2007 established various floodplain management requirements for cities and counties related to local land use planning. Regional agencies with land use and permitting authority may seek and obtain help from the State in implementing the new flood risk mapping and assessment requirements.

Most of the agricultural lands in the region are currently mapped, or will soon be mapped, as FEMA regulated floodplains, or Special Flood Hazard Areas (SFHA). For most of these areas, it is unlikely that the SFHA restrictions will be lifted in the foreseeable future, due to the high cost of improving levees to meet FEMA's 100-year flood protection criteria and the goals established by the CVFPP.

Accurate and up-to-date flood hazard maps are very useful tools to help manage flood risks and allocate risk reduction resources. For example, the property owners along Cherokee Canal have requested that the flood hazard maps be updated to accurately define the extent and depth of flooding associated with potential overflow and failure of the Cherokee Canal levee system.

Agricultural lands provide beneficial and low risk uses of floodplain lands. However, the restrictions imposed under NFIP for such SFHAs do not provide the flexibility needed to sustain agriculture over time, including upgrading and expanding the infrastructure needed to support efficient and competitive agricultural operations, as well as to recover from occasional flooding. Although agricultural use is consistent with floodplain management principles, the current regulations impose restrictions and financial burdens are making such use increasingly difficult to sustain over time.

Specifically, in order to meet the regulatory requirements of investment in agriculture in SFHAs, structures must be wet flood proofed, dry flood proofed, or elevated. These requirements are infeasible or cost prohibitive, especially in areas protected by levees with BFEs above 10 feet. In addition, all federally backed mortgages for properties in SFHAs require federally mandated flood insurance.

Accordingly, changes are needed to the NFIP that will promote the sustainability of agriculture in the region, as well as elsewhere in California and the nation. The proposed changes described below are consistent with floodplain management principles and will minimize the risk of increased urbanization of the floodplain by facilitating continued agricultural use.

- Amend federal law to allow FEMA to establish a FEMA flood zone for agriculturally based communities, which would allow for replacement or reinvestment in infrastructure needed to sustain existing agricultural use in floodplains.
- Direct or support action by FEMA to develop and use insurance actuarial rates that reflect the actual flood risks within each levee-protected zone, based on best available hydrologic, hydraulic, and geotechnical analyses. This would lead to more efficient allocation of investment resources based on true economic risk, with regional and national economic benefits. It is important to keep in mind that levees provide protection, even if they are not certifiable. An actuarial rating system should be developed for unaccredited levee systems to avoid imposing undue burdens on agricultural communities.
- Establish State and federal post-disaster agricultural recovery programs that recognize the national importance of sustainable agriculture, the consistency of agriculture with the wise use of floodplains, and that recovery from occasional flooding due to levee failures

in SFHAs should be an integral part of such sustainable land use. Such post-disaster agricultural recovery programs could include low-interest loans, grants, technical assistance, and other tools, which could be developed in consultation with agricultural interests. They could include linkages to incorporating additional wildlife-friendly agricultural practices to attract more favorable loans and grants while accomplishing State and national environmental restoration goals.

9.3.2 Development Impact Fee Program

Regional agencies such as counties and cities exert jurisdiction over land use within their boundaries. Concerns about the increase in Expected Annual Damage (EAD), which occurs when development occurs in floodplains can be mitigated by improving the capacity and reliability of flood protection concurrently with development. In this way increase in damageable property is balanced by the reduced chance of flooding, thus breaking the cycle of improvements in flood protection resulting in increased cumulative risk as development follows. Such a fee program is consistent with the State's goals of reducing the risk of flooding over time, while fostering robust economic health and environmental quality throughout the region. It is therefore more likely that regional projects to improve levees will garner State cost-sharing support when combined with programs, such as this that address long-term concerns about the growing risk of flood damages. The application of a development impact fee program can also encourage more compact development, because the cost of offsetting new development flood exposure with improved flood protection is lower for compact development.

It is also important to note that properties within a levee protected area may be subject to a variety of fees, which collectively may create a heavy fee and taxation burden. Thus any new fee program, such as a Development Impact Fee, in the context of the existing and anticipated financing strategies of local, State, and federal programs.

9.3.3 Agricultural and Environmental Conservation Easements

Agricultural and environmental conservation easements that preserve agriculture, prevent urban development in current agricultural areas, or achieve specific environmental conservation goals can advance regional goals of improving the sustainability of agriculture, limiting future flood damages, and improving environmental quality. They serve as a useful tool for attracting State and Non-Governmental Organization (NGO) funding to support permanent agricultural use and environmental enhancement. When consistent with local land use plans, and supported by local land owners, such programs can be a source of additional financial support for property owners while advancing regional and State goals and objectives. Incorporation of easement programs in the suite of floodplain management and flood risk management tools is also likely to improve the chances of State support for levee improvement projects. Easement programs are discussed in greater detail in Chapter 6.

10 Alternatives Evaluation, Comparison, and Prioritization

The alternative flood management actions and programs that could benefit the Feather River Region and the system as a whole were described in the previous chapter. Evaluating, comparing, and setting priorities among them is a challenging undertaking, particularly when comparing very different types of actions. Thoughtful analyses, taking into consideration all relevant knowledge about the region and its functional relationships and supported by qualitative and quantitative objectives can provide a balanced approach.

10.1 Evaluation, Comparison, and Prioritization Criteria (and Metrics)

Proposed evaluation, comparison, and prioritization criteria and metrics include the following.

10.1.1 Financial Feasibility

The financial feasibility of a project is influenced by several factors that include project cost, the benefits and economic incentives of the project, the ability to obtain funding from a variety of sources, and the ability to capitalize those funding sources.

Project Costs – Costs are typically broken down into the capital and O&M costs. A full analysis of these costs can be quite complex and will necessarily be founded on a number of assumptions about near-term and long-term factors such as interest rates on debt, inflation rates, and project life. O&M costs are affected by a multitude of factors beyond the control of the LMA, including changes in O&M constraints and criteria, equipment permitting and operational costs, labor, insurance, and fees. Capital and O&M costs are typically combined into a single project cost for comparison purposes and expressed either as a combined present value or annual cost.

Although the life of a project for financial planning purposes is typically set at 50 years or less, flood management projects can be expected to persist in their constructed configurations for much longer, which adds a qualitative dimension to this analysis. In general, given the uncertainty about future O&M costs, projects that minimize future O&M costs will be viewed as providing greater sustainability, flexibility, and reliability, other things being equal.

Economic Benefits and Incentives – As discussed further below, projects have the possibility of generating economic benefits through flood risk reduction. In certain circumstances, those benefits may generate real value as opportunity cost savings when a project presents a choice between two mutually exclusive alternatives. The financial feasibility of project can be measured by the magnitude of the realized opportunity cost savings as greater value relates to the higher likelihood to capturing that savings as a source of funding.

Availability of Outside Funding Sources - Financial feasibility also includes the potential for State, federal, and non-local cost sharing through the alignment of the project with the objective criteria of non-local project sponsors.

Economic Conditions – Financial feasibility also addresses the ability of a project to capitalize various revenue sources to meet the cash flow requirements of project implementation. This

includes factors such as capital market conditions and the credit worthiness of the project sponsor and the revenue source.

10.1.2 Implementation Feasibility

Implementation feasibility is a broad term that summarizes the potential likelihood of successfully implementing an action. A myriad of specific factors, such as availability of right-of-way, the willingness of affected property owners to sell real estate needed for project facilities, technical challenges, permitting constraints, environmental impacts, and public acceptability, to name a few, could all affect feasibility.

A careful analysis of each action, the likely implementation steps, and the challenges associated with each of those steps, is needed to assess feasibility. This is a critically important analysis, which should be reviewed at each stage of the planning process, from reconnaissance to final design. Projects which are further along in the planning process (“project readiness”), having addressed potential implementation challenges along the way, are more likely to be considered for State and local funding than projects in the early planning stages.

10.1.3 Flood risk reduction benefits

There are a number of potential measures of flood risk reduction benefits, such as EAD; number of people protected; anticipated frequency of inundation; direct damage to lands, crops, and structures; indirect impacts on the local, regional, State, and national economies; risk of ecological damage; effects on water quality; and other effects. The CVFPP has established a “worst-first” approach, in which it will most likely give the highest priority to projects that address the most significant system weaknesses first in a cost-effective manner. It has also set protection of urban areas, urbanizing areas, and small communities, with the highest concentrations of people and property, as highest priorities. However, it is also important to improve flood protection for rural-agricultural areas, which should be prioritized under a separate category to assure that they are not left behind. All of these factors should be considered, although it is often difficult to quantify them.

10.1.4 Comparative effectiveness

There are often many ways to accomplish particular project goals and objectives. Various approaches can be compared on the basis of the extent to which the benefits are achieved, the comparative costs, and the likely impacts. Such comparisons are especially important in the alternatives refinement phase of project planning.

10.1.5 Consistency with regional goals and objectives

Based on an understanding of how the system functions under current and anticipated conditions, this criterion evaluates how a proposed alternative action contributes to the regional goals and objectives, alone and in concert with other alternative actions.

10.1.6 Consistency with CVFPP, including multi-objective benefits

The CVFPP goals and objectives are aimed at improving overall flood system capacity, resiliency, reliability, sustainability, and environmental quality. Of fundamental importance is ensuring that the hydraulic function of the system as a whole is improved, as reflected by increased floodplain storage, improved conveyance capacity, and reduced peak flood stages.

By their very nature, flood management projects can have profound effects on landscape features, land use, and regional hydrology, with far reaching effects on natural resources. While a detailed environmental impact analysis of each action is not included in this regional planning study, the potential impacts and benefits are broadly considered.

Quantitative descriptors which can help to define changes in environmental quality can include changes in land use acreages, habitat types, the ratio of habitat area to habitat boundary length, frequency and duration of flood inundation, wildlife population density, corridor effects for fish and wildlife migration, and others. Efforts to describe habitat value benefits in quantitative terms, such as the USFWS Habitat Evaluation Procedure (HEP) may be helpful in assessing likely benefits and impacts. These measures are all, as long as the underlying complexity of the system is recognized and taken into consideration in the analysis.

Multi-objective projects, which improve fisheries and wildlife habitat, restore ecological processes, reduce operation and maintenance costs, improve water quality, protect open space, provide recreational opportunities and improve the resiliency of the biotic community will have a much higher likelihood of State funding, consistent with the stated goals and objectives of the CVFPP.

10.2 Grouping of Priority Lists

Once alternative actions have been evaluated by the various appropriate metrics and criteria described above, it is necessary to group them and establish priorities. This is a precursor to formulating a final financing strategy for the region.

There are several potential approaches to grouping potential actions.

1. Create a master list of actions, and then engage the regional planning participants in discussions and negotiations to arrive at a prioritized list.
2. Organize actions into groups corresponding to the sub-basins protected in the region, which would generally conform to the existing boundaries of local agencies that are at risk from the failure of the same levee segments. This provides a natural framework for setting priorities among levee segments, and for levying assessments for improvements.
3. Further subdivide actions into categories by type, such as levee improvements, reservoir structural and operational improvements, channel improvements, and residual risk improvements. This approach also helps in the prioritization process because these various types of improvements may rely on very different sources of funding, with distinct cost-sharing opportunities and constraints.

In this planning effort the third approach has been selected for the initial prioritization effort. The priority list is grouped as outlined in Table 10-1. As the actions are refined and funding mechanisms and opportunities are more clearly developed, prioritization across these groups can be accomplished with the input of affected stakeholders.

10.3 Alternatives Evaluation

The alternative actions, which have been described in chapters 7, 8, and 9, were evaluated to determine the extent to which they achieve the CVFPP goals and objectives, the regional goals and objectives, and their feasibility, also summarized in Table 10-1. Sections 1.3.1 through 1.3.6

below provide the criteria to be met for actions to receive a check mark in that category in Table 10-1.

10.3.1 Alternatives Prioritization

Regional priorities were developed in concert with Financial Plan development and are displayed in order of local priority in Table 10-1. Some projects, particularly major levee improvement projects for rural-agricultural areas, are likely not financially feasible under current conditions. However, it is important to identify all significant project priorities in this Plan in order to be prepared to take advantage of changing conditions and funding opportunities.

10.3.2 CVFPP Objectives

Regional priorities were evaluated by the RFMP team to determine which objectives they met. Actions are considered to meet the objective based on the following criteria.

- Improve Flood Risk Management – any actions that directly reduce the chance of flooding, damages when flooding occurs, or improves public safety, preparedness, and emergency response. Typically includes flood control structural and/or non-structural projects. Does not include studies, patrol road repairs, ecosystem enhancement or recreational projects that will not directly improve flood conveyance or storage.
- Improve Operations and Maintenance – Actions that 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 operations and maintenance, including significant repair projects. Actions may also include correcting right of way deficiencies and encroachment issues.
- 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. Projects that include strengthen in place repairs, unless ecosystem enhancements have specifically been identified, and structural levee repair/improvement projects still in the planning phase are not considered to promote ecosystem functions. Erosion projects, although they often incorporate enhancement measures and/or mitigation, are also assumed not to promote ecosystem functions to avoid double counting mitigation and enhancements.
- Improve Institutional Support – Actions that develop stable institutional structures, coordination protocols, and financial frameworks that enable effective and adaptive integrated flood management (designs, operations and maintenance, permitting, preparedness, response, recovery, and land use and development planning). Projects include those that directly provide for evaluation or implementation of changes to standards, support ongoing FERC re-licensing activities, and those that correct legacy right of way issues, legacy encroachment issues, correct remnant levee issues, or solve other legacy issues in the system.
- Promote Multi-Benefit Projects - The plan has intentionally kept flood risk, environmental, and recreational projects separate in this evaluation. The reason for this separation is to preserve future project planner's ability to bundle various actions or projects together to maximize funding opportunities at the time while preserving the ability for actions to be implemented separately if and when resources become available. All of the projects have the ability to bundle multi-objective actions to achieve the

regional and CVFPP goals. Only projects or actions that independently provide multi-objective benefits are included.

10.3.3 Regional Goals and Objectives

Evaluation criteria for regional goals and objectives are discussed below.

- Urban and Urbanizing – includes actions that provide meaningful progress towards achieving 200-year protection for urban or urbanizing areas.
- Small Communities - includes actions that provide meaningful progress towards achieving 100-year protection of small communities.
- Rural Agricultural Area - includes actions that improve flood protection and/or risk management for rural areas.
- Multiple Objectives – criteria are the same as for the CVFPP objectives.
- SSIA and Regional Projects – includes actions that provide opportunities to link SSIA to regional projects and/or objectives.

10.3.4 Costs

Evaluation of specific costs and benefits of the actions was beyond the scope of this planning effort. However, the following categories were included in Table 10-1 and left blank for use in future planning or implementation efforts.

- Capital Costs
- Operation and Maintenance
- Annualized

10.3.5 Benefits

Evaluation of specific costs and benefits of the actions was beyond the scope of this planning effort. However, the following categories were included in Table 10-1 and left blank for use in future planning or implementation efforts.

- Flood Damage Reduction
- Ecosystem

10.3.6 Implementability

Evaluation of the implementability of the actions was based on the following criteria.

- Readiness – includes projects that are ready to be implemented, including structural, non-structural, and studies, and could proceed assuming adequate funding was available within the next 12 months.
- Funding Opportunities – includes projects that have currently available non-local funding sources.
- Acceptability – includes projects that appear to have overall regional support for implementation.

Project Characteristics					
PROJECTS AND DESCRIPTIONS		Timeframe	Agency/ Project Sponsor	Preliminary Project Estimate	Estimated State Share
BASIN SPECIFIC FLOOD RISK REDUCTION PROJECTS					
SUTTER BASIN					
L1	FRWLPI, Thermalito to Laurel Avenue,, achieve 200-year protection for urban areas, cost shared with State	Summer 2013	SBFCA	\$290,000,000	\$235,000,000
L2A	Star Bend to Laurel Avenue		SBFCA	\$60,000,000	
L2A	Laurel to Cypress Critical Repair		SBFCA	\$13,500,000	\$11,475,000
L2A	Star Bend South Critical Repair		SBFCA	\$8,800,000	\$7,480,000
L2B	Additional projects to achieve 100-year flood protection for the southern portions of the basin, cost shared with the State, and collaborate with the State on comprehensive repairs or replacement of the Sutter Bypass East Levee. In parallel, repair critically damaged levees on the existing West Feather River levee and Sutter Bypass, and achieve a FEMA Ag Zone coupled with affordable insurance premiums.		SBFCA	\$191,277,000	
L4	Gridley Bridge Bank Erosion Repair Design, Permitting & Construction		SBFCA	\$5,460,000	\$4,260,000
L5	Oroville Wildlife Area Flood Stage Reduction Project Design, Permitting & Construction	2014-2015	SBFCA	\$5,000,000	TBD
L6	Rural Levee Reliability Study (2)		SBFCA	\$995,000	\$995,000
L7	Sutter Bypass/Wadsworth Critical Repairs	Spring 2016	SBFCA		
CHEROKEE CANAL					
L1	Sedimentation Basin(s)				
L2	Levee improvements – Right Bank near Richvale				
L3	Bridge Crossing Improvement				
L4	Relief Weir, Left bank upstream of Richvale				
RECLAMATION DISTRICT 10					
L1A	RD 10 Feather River FSRP Through-Seepage Mitigation Design	2014	RD 10	\$130,000	\$110,500
L1B	RD 10 Critical Seepage Repair		RD 10	\$310,000	
L2	RD 10 FSRP All Weather Patrol Roads Construction	2014-2015	RD 10	\$1,380,000	\$1,173,000
L3	Improved rodent control and rodent burrow mitigation		RD 10	\$949,850	
L4	Seepage and underseepage site remediation		RD 10	\$1,623,050	
L5	Erosion protection at identified sites vulnerable sites		RD 10	\$1,006,236	
L6	Improve drainage along levee landside toe to improve visibility, flood fight access, and levee stability		RD 10	\$742,500	
L7	Evaluate, design, and construct levee improvements to achieve USACE project levee geometry and stability standards-- prioritized based on risk		RD 10	\$175,657,000	
MARYSVILLE LEVEE DISTRICT (MLD)					
L1	Marysville Ring Levee Phase 2B Design & Construction	2016-2017	MLD	\$19,000,000	\$13,300,000
L2	Marysville Ring Levee Phase 3 Design & Construction	2017-2018	MLD	\$21,200,000	\$14,840,000
L3	Marysville Ring Levee Phase 2C Design & Construction	2018-2019	MLD	\$13,000,000	\$9,100,000
L4	All-weather patrol road improvements (augment aggregate base, grading)		MLD	\$50,000	
TRLIA/ RECLAMATION DISTRICT 784					
L1	Phase IV—Complete WPRR levee improvements		TRLIA	\$15,228,000	
L2	Resolve ROW and encroachment issues for levees protecting urban areas		TRLIA	\$4,000,000	
L3	Yuba Goldfields Design & Construction	2019-2020	TRLIA	\$20,000,000	\$14,000,000
L4	Olivehurst Detention Basin (Construction completed. Action is to adopt as SPFC facility)		TRLIA	\$50,000	
L5	Yuba River South Levee ULDC Remediation		TRLIA	\$1,500,000	
L6	WPIC ULDC Remediation Design & Construction	Ongoing- 2015	TRLIA	\$15,150,000	\$10,605,000
L7	Yuba 86 Break Site Berm Design & Construction	Ongoing - Mid 2015	TRLIA	\$1,500,000	\$1,050,000
L8	Upper Bear TAC	2017	TRLIA	\$20,000	\$14,000
L9A	Yuba TAC (UPRR to Silverwood)	2017	TRLIA	\$500,000	\$350,000
L9B	Yuba TAC (Silverwood)	2017	TRLIA	\$10,000,000	\$7,000,000
L9C	Yuba TAC (Silverwood to Simpson Ln.)	2017	TRLIA	\$500,000	\$350,000
L10A	RD 784 Site 7 Relief Well Rehabilitation Construction	2014	TRLIA	\$200,000	\$140,000
L10B	RD 784 Pump Station 2 Improvements Construction	2015	RD784	\$825,000	\$577,500
L10C	RD 784 Pump Station 10 Improvements Construction	2016	RD784	\$3,625,000	\$2,537,500
L10D	RD 784 Pump Station 9 Back up generators Construction	2017	RD	\$300,000	\$210,000
L10E	RD 784 Pump Station 5 Improvements Construction	2018	RD	\$3,500,000	\$2,450,000
L10F	RD 784 Pump Station 7 Improvements Construction	2019	RD	\$2,525,000	\$1,767,500
WHEATLAND (2103, 817)					
L1	RD 817 Bear River FSRP Setback Levee Design & Construction	2014-2016	WHEATLAND	\$8,500,000	\$8,075,000
L2	Dry Creek develop new hydrology		WHEATLAND	\$60,000	
L3	Dry Creek south levee and San Joaquin ditch (3.9 mi) improvements feasibility study and environmental documentation to formulate preferred alternative approach		WHEATLAND	\$760,000	
L4	Develop more accurate FEMA 100-year maps for the existing developed area that floods from Dry Creek		WHEATLAND	\$40,000	
L5A	RD 2103 Dry Creek Study, Design & Construction	Underway-2020	WHEATLAND	\$56,767,000	\$39,967,000
L5B	RD 2103 Dry Creek Levee Repairs		WHEATLAND	\$24,470,000	
L6	This is a feasibility study to evaluate 100 year alternatives for repairs on the southern portion of the Dry Creek Levee and Bear River in RD 817 protecting the city of Wheatland.		WHEATLAND	\$797,000	
L7	Bear River 200-year ULDC Rehabilitation Study, Design & Construction	2018-2021	WHEATLAND	\$7,600,000	\$5,320,000
L8	Evaluate, design, and construct levee improvements to achieve USACE project levee geometry and stability standards-- prioritized based on risk; Remaining segments in RD 817		WHEATLAND	\$100,058,000	
L9	Evaluate, design, and construct levee improvements to achieve USACE project levee geometry and stability standards-- prioritized based on risk Remaining segments in RD 2103		WHEATLAND	\$4,252,000	
L10A	RD 817 FSRP All Weather Patrol Roads Construction	2014	WHEATLAND	\$270,000	\$229,500
L10B	RD 2103 FSRP All Weather Patrol Roads Construction	2014	WHEATLAND	\$240,000	\$204,000

Table 10-1. Alternatives Evaluation and Comparison Framework, Page 1

Project Characteristics					
PROJECTS AND DESCRIPTIONS		Timeframe	Agency/ Project Sponsor	Preliminary Project Estimate	Estimated State Share
RECLAMATION DISTRICT 1001					
L1	Address specific seepage, underseepage, erosion, and stability concerns for the Feather River levee, from the Natomas Cross Canal to the River Oaks Golf Course (Levee Unit 4, Levee Miles 5.2 to 13.4).		RD 1001	\$5,100,000	
L2	Re-rock levee crown patrol roads		RD 1001	\$943,811	
L3	Repair, replace, or abandon existing drains and pipes through the levees		RD 1001	\$86,680	
L4	Improve erosion protection along the Bear River south levee		RD 1001	\$2,561,328	
L5	Floodproofing Main Drain Pumping Plant		RD 1001	\$500,000	
L6	Construct a new pumping plant on the Cross Canal at end of Lateral 4		RD 1001	\$1,000,000	
L7	Replace or improve Main Drain pumping plant		RD 1001	\$8,000,000	
L8	Phased improvements to the RD1001 levee system to achieve 100-year FEMA levee protection		RD 1001		
L8-A	Natomas Cross Canal north levee		RD 1001	\$123,878,000	
L8-B	Feather River east levee, Cross Canal to River Oaks Golf Course		RD 1001	\$349,758,000	
L8-C	Bear River south bank, Yankee Slough to Pleasant Grove Road		RD 1001	\$75,148,000	
L8-D	Yankee Slough north and south bank, from confluence to Pleasant Grove Road		RD 1001	\$57,547,000	
L8-E	Bear River south bank, Pleasant Grove Road to high ground		RD 1001	\$109,742,000	
L8-F	Coon Creek Group Interceptor Canal Levee, Natomas Cross Canal to high ground		RD 1001	\$13,503,000	
CHANNEL IMPROVEMENTS					
C1	Cherokee Canal Corridor Management		DWR		
C2	Nelson Weir removal or modification to reduce erosion and improve habitat		DWR	\$2,640,000	
C3	4 million CY of sediment removal Downstream of Nelson Weir (Corridor Management Plan)		DWR	\$40,000,000	
OPERATION AND MAINTAINANCE					
O1	Flood Control O&M Consolidation Study	2014-2015	TRLIA	\$200,000	\$140,000
RESERVOIR STRUCTURAL IMPROVEMENTS					
R1	Bullards Bar Outlet Modifications Design/Construct	2016-2022	YCWA	\$140,000,000	\$98,000,000
R2	Colgate Tailwater Depression Project Design & Construction	2017	YCWA	\$4,900,000	\$3,430,000
RESERVOIR OPERATIONS					
RES1	Forecast-Coordinated Operations for Yuba and Feather Rivers (F-CO)		DWR, YCWA	\$2,000,000	
RES2	Forecast-Based Operations (F-BO)		DWR	\$20,000,000	
ECOSYSTEM ENHANCEMENT AND RESTORATION OPPORTUNITIES					
E1	Oroville Wildlife Area Multi-Benefit Project		SBFCA	5,000,000	
E1	TRLIA Feather River Levee Setback Ecosystem enhancement		TRLIA	4,700,000	
E1	Feather Restoration Site - Phase 1 Design & Construction	2015-2016	TRLIA	\$5,360,000	\$5,360,000
E1	Feather Restoration Site - Phase 2 Design & Construction	2017-2018	TRLIA	\$18,200,000	\$18,200,000
E1	FESSRO/TRLIA Advance Mitigation Site Restoration	2014-2017	DWR/TRLIA	\$4,400,000	\$4,400,000
E1	LD1 Star Bend Levee Setback Ecosystem enhancement	TBD	LD1, SBFCA	\$650,000	
E1	Feather River Wildlife Area - Abbot Lake Unit	Summer 2015	CDFW, SFFCA	\$944,480	\$0
E1	Laurel Avenue Levee Setback		To be determined	\$70,000,000	
E1	Feather River Wildlife Area - Nelson Slough Unit		CDFW	\$10,000,000	
E1	Sutter Main Canal relocation to enhance salmonid temperature control and improve maintenance efficiency (FERC Process)				
E1	Expand Willow Island Recreation Area, Yuba City				
E1	Purchase of Agricultural Easements (assumed cost per acre)		To be determined	\$2,500	
E1					
E1	Thermalito Afterbay Brood Ponds		DWR	\$9,000,000	
E1	Hamilton Slough		To be determined	\$5,000,000	
E1	Live Oak Park		Sutter County	\$750,000	TBD
E1	Feather River Wildlife Area – O'Connor Lakes Unit	Summer 2015	CDFW	\$2,500,000	\$2,500,000
E1	Sutter Bypass Wildlife Area		CDFW	\$3,000,000	
E1	Sutter National Wildlife Refuge		USFWS	\$1,500,000	
E1	Lower Yuba River Native Fish Habitat Enhancement		YCWA	To be determined	
E1	Sunset Weir(DWR FERC Settlement Agreement)		To be determined	\$2,000,000	
E1	Gridley Open Space Restoration	Summer 2014		TBD	TBD

Table 10-1. Alternatives Evaluation and Comparison Framework, Page 2

Table 10-1. Alternatives Evaluation and Comparison Framework, Page 3

PROJECTS AND DESCRIPTIONS		Achieve CVFPP and Regional Goals and Objectives											Comparative Feasibility								
		CVFPP Objectives					Regional Goals and Objectives						Costs		Benefits		Implementability				
		Primary		Supporting			Urban and Urbanizing	Small Communities	Rural/Agricultural Areas	Flood System Sustainability	Agricultural Sustainability	Multiple Objectives	SSIA and Regional Projects	Capital Costs	Operation and Maintenance	Annualized	Flood Damage Reduction	Ecosystem	Readiness	Funding Opportunities	Acceptability
		Improve Flood Risk Management	Improve Operations and Maintenance	Promote Ecosystem Functions	Improve Institutional Support	Promote Multi-Benefit Projects															
BASIN SPECIFIC FLOOD RISK REDUCTION PROJECTS																					
SUTTER BASIN																					
L1	FRWLP, Thermalito to Laurel Avenue, achieve 200-year protection for urban areas, cost shared with State	X	X				X	X	X	X	X							X	X	X	
L2	Star Bend to Laurel Avenue	X	X					X	X	X	X									X	
L2A	Laurel to Cypress Critical Repair	X	X					X	X	X	X								X	X	
L2B	Star Bend South Critical Repair	X	X					X	X	X	X							X	X	X	
L2C	Additional projects to achieve 100-year flood protection for the southern portions of the basin, cost shared with the State, and collaborate with the State on comprehensive repairs or replacement of the Sutter Bypass East Levee. In parallel, repair critically damaged levees on the existing West Feather River levee and Sutter Bypass, and achieve a FEMA Ag Zone coupled with affordable insurance premiums.	X	X					X	X	X	X									X	
L4	Gridley Bridge Bank Erosion Repair Design, Permitting & Construction	X	X					X	X	X								X	X	X	
L5	Oroville Wildlife Area Flood Stage Reduction Project Design, Permitting & Construction	X	X	X		X	X	X	X	X	X	X						X	X	X	
L6	Rural Levee Reliability Study (2)							X		X	X							X		X	
L7	Sutter Bypass/Wadsworth Critical Repairs	X	X					X	X	X	X									X	
CHEROKEE CANAL																					
L1	Sedimentation Basin(s)	X	X	X		X		X	X	X	X	X	X							X	
L2	Levee improvements – Right Bank near Richvale	X	X					X		X										X	
L3	Bridge Crossing Improvement	X	X					X		X										X	
L4	Relief Weir, Left bank upstream of Richvale	X																			
RECLAMATION DISTRICT 10																					
L1A	RD 10 Feather River FSRP Through-Seepage Mitigation Design	X	X					X	X	X								X		X	
L1B	RD 10 Critical Seepage Repair	X	X					X	X	X								X		X	
L2	RD 10 FSRP All Weather Patrol Roads Construction		X					X	X	X	X							X		X	
L3	Improved rodent control and rodent burrow mitigation	X	X					X	X	X								X		X	
L4	Seepage and underseepage site remediation	X	X					X	X	X										X	
L5	Erosion protection at identified sites vulnerable sites	X	X					X	X	X										X	
L6	Improve drainage along levee landside toe to improve visibility, flood fight access, and levee stability	X	X					X	X	X										X	
L7	Evaluate, design, and construct levee improvements to achieve USACE project levee geometry and stability standards-- prioritized based on risk	X	X					X	X	X										X	
MARYSVILLE LEVEE DISTRICT (MLD)																					
L1	Marysville Ring Levee Phase 2B Design & Construction	X	X			X		X			X							X	X	X	
L2	Marysville Ring Levee Phase 3 Design & Construction	X	X			X		X			X							X	X	X	
L3	Marysville Ring Levee Phase 2C Design & Construction	X	X			X		X			X							X	X	X	
L4	All-weather patrol road improvements (augment aggregate base, grading)		X			X		X			X							X	X	X	
TRLIA/ RECLAMATION DISTRICT 784																					
L1	Phase IV—Complete WPIC levee improvements	X	X			X		X	X	X	X							X	X	X	
L2	Resolve ROW and encroachment issues for levees protecting urban areas		X		X	X		X										X		X	
L3	Yuba Goldfields Design & Construction	X	X	X		X		X	X	X	X							X	X	X	
L4	Olivehurst Detention Basin (Construction completed. Action is to adopt as SPFC facility)		X		X	X		X	X	X	X							X	X	X	
L5	Yuba River South Levee ULDC Remediation	X	X			X		X	X	X	X							X	X	X	
L6	WPIC ULDC Remediation Design & Construction	X	X			X		X	X	X	X							X	X	X	
L7	Yuba 86 Break Site Berm Design & Construction	X	X			X		X	X	X	X							X	X	X	
L8	Upper Bear TAC		X		X	X		X										X		X	
L9A	Yuba TAC (UPRR to Silverwood)		X		X	X		X										X		X	
L9B	Yuba TAC (Silverwood)		X		X	X		X												X	
L9C	Yuba TAC (Silverwood to Simpson Ln.)		X		X	X		X										X		X	
L10A	RD 784 Site 7 Relief Well Rehabilitation Construction	X	X			X		X	X									X		X	
L10B	RD 784 Pump Station 2 Improvements Construction	X	X			X		X	X									X		X	
L10C	RD 784 Pump Station 10 Improvements Construction	X	X			X		X	X									X		X	
L10D	RD 784 Pump Station 9 Back-up generators Construction	X	X			X		X	X									X		X	
L10E	RD 784 Pump Station 5 Improvements Construction	X	X			X		X	X									X		X	
L10F	RD 784 Pump Station 7 Improvements Construction	X	X			X		X	X									X		X	
WHEATLAND (2103, 817)																					
L1	RD 817 Bear River FSRP Setback Levee Design & Construction	X	X	X		X		X	X	X	X	X						X	X	X	
L2A	RD 817 FSRP All Weather Patrol Roads Construction		X					X	X	X	X							X	X	X	
L2B	RD 2103 FSRP All Weather Patrol Roads Construction		X			X	X	X	X	X	X							X	X	X	
L3	Dry Creek develop new hydrology				X	X	X	X		X								X	X	X	
L4	RD 2103 Dry Creek south levee and (3.9 mi) feasibility study and environmental documentation to formulate preferred alternative approach					X	X	X	X	X								X	X	X	
L5	Develop more accurate FEMA 100-year maps for the existing developed area	X			X	X	X	X		X								X		X	
L6	RD 2103 Dry Creek Design & Construction	X	X			X	X	X	X	X										X	
L7	Evaluate, design, and construct levee improvements to achieve USACE project levee geometry and stability standards, prioritized based on risk in RD 817	X	X					X	X	X	X									X	
L8	Bear River 200-year ULDC Rehabilitation Study, Design & Construction	X	X			X	X	X	X	X	X									X	

PROJECTS AND DESCRIPTIONS		Achieve CVFPP and Regional Goals and Objectives											Comparative Feasibility								
		CVFPP Objectives					Regional Goals and Objectives						Costs			Benefits		Implementability			
		Primary	Supporting				Urban and Urbanizing	Small Communities	Rural Agricultural Areas	Flood System Sustainability	Agricultural Sustainability	Multiple Objectives	SSIA and Regional Projects	Capital Costs	Operation and Maintenance	Annualized	Flood Damage Reduction	Ecosystem	Readiness	Funding Opportunities	Acceptability
		Improve Flood Risk Management	Improve Operations and Maintenance	Promote Ecosystem Functions	Improve Institutional Support	Promote Multi-Benefit Projects															
RECLAMATION DISTRICT 1001																					
L1	Address specific seepage, underseepage, erosion, and stability concerns for the Feather River levee, from the Natomas Cross Canal to the River Oaks Golf Course (Levee Unit 4, Levee Miles 5.2 to 13.4).	X	X				X	X	X	X	X						X	X	X		
L2	Re-rock levee crown patrol roads		X				X	X	X	X	X						X	X	X		
L3	Repair, replace, or abandon existing drains and pipes through the levees	X	X				X	X	X	X	X						X		X		
L4	Improve erosion protection along the Bear River south levee	X	X				X	X	X	X							X	X	X		
L5	Floodproofing Main Drain Pumping Plant	X	X					X	X	X							X		X		
L6	Construct a new pumping plant on the Cross Canal at end of Lateral 4	X	X					X	X	X									X		
L7	Replace or improve Main Drain pumping plant	X	X					X	X	X									X		
L8	Phased improvements to the RD1001 levee system to achieve 100-year FEMA levee protection																				
L8-A	Natomas Cross Canal north levee	X	X				X	X	X	X	X								X		
L8-B	Feather River east levee, Cross Canal to River Oaks Golf Course	X	X				X	X	X	X	X								X		
L8-C	Bear River south bank, Yankee Slough to Pleasant Grove Road	X	X				X	X	X	X	X								X		
L8-D	Yankee Slough north and south bank, from confluence to Pleasant Grove Road	X	X				X	X	X	X	X								X		
L8-E	Bear River south bank, Pleasant Grove Road to high ground	X	X				X	X	X	X	X								X		
L8-F	Coon Creek Group Interceptor Canal Levee, Natomas Cross Canal to high ground	X	X				X	X	X	X	X								X		
CHANNEL IMPROVEMENTS																					
C1	Nelson Weir removal or modification to reduce erosion and improve habitat	X	X	X	X	X	X	X	X	X	X	X							X	X	
C2	4 million CY of sediment removal Downstream of Nelson Weir (Corridor Management Plan)	X		X		X	X	X	X	X	X	X							X	X	
OPERATION AND MAINTAINANCE																					
O1	Flood Control O&M Consolidation Study		X		X		X	X	X	X	X	X							X	X	X
RESERVOIR STRUCTURAL IMPROVEMENTS																					
R1	Bullards Bar Outlet Modifications Design/Construct	X				X	X	X	X	X	X	X							X	X	X
R2	Colgate Tailwater Depression Project Design & Construction	X			X	X	X	X	X	X	X	X							X	X	X
RESERVOIR OPERATIONS																					
RES1	Forecast-Coordinated Operations for Yuba and Feather Rivers (F-CO)	X			X		X	X	X	X	X	X							X	X	X
RES2	Forecast-Based Operations (F-BO)	X			X		X	X	X	X	X	X							X	X	X
ECOSYSTEM ENHANCEMENT AND RESTORATION OPPORTUNITIES																					
E1	Oroville Wildlife Area Multi-Benefit Project	X	X	X	X	X	X	X	X	X	X	X					X	X	X	X	
E1	TRLIA Feather River Levee Setback Ecosystem enhancement	X		X						X	X	X					X	X	X	X	
E1	Feather Restoration Site - Phase 1 Design & Construction	X	X	X		X				X	X	X	X				X	X	X	X	
E1	Feather Restoration Site - Phase 2 Design & Construction	X	X	X		X				X	X	X	X				X	X	X	X	
E1	FESSRO/TRLIA Advance Mitigation Site Restoration		X		X	X				X		X					X	X	X	X	
E1	LD1 Star Bend Levee Setback Ecosystem enhancement			X								X							X	X	
E1	Feather River Wildlife Area - Abbot Lake Unit		X	X	X							X							X	X	
E1	Laurel Avenue Levee Setback	X	X	X		X						X	X						X		
E1	Feather River Wildlife Area - Nelson Slough Unit			X								X							X	X	
E1	Sutter Main Canal relocation to enhance salmonid temperature control and improve maintenance efficiency (FERC Process)		X	X	X	X				X	X	X	X						X	X	
E1	Expand Willow Island Recreation Area, Yuba City			X		X						X	X						X	X	
E1	Purchase of Agricultural Easements	X		X	X	X	X	X	X	X	X	X							X	X	
E1	Thermalito Afterbay Brood Ponds			X								X							X	X	
E1	Hamilton Slough	X		X								X							X	X	
E1	Live Oak Park			X								X							X	X	
E1	Feather River Wildlife Area - O'Connor Lakes Unit			X								X							X	X	
E1	Sutter Bypass Wildlife Area			X								X							X	X	
E1	Sutter National Wildlife Refuge			X								X							X	X	
E1	Lower Yuba River Native Fish Habitat Enhancement			X								X							X	X	
E1	Sunset Weir(DWR FERC Settlement Agreement)			X	X	X						X	X						X	X	
E1	Gridley Open Space Restoration			X								X							X	X	
RECREATIONAL OPPORTUNITIES (See Table 7-1)																					
	Multi-Use trails											X							X		
	Day Use Areas											X							X		
	Hunting and Fishing Facilities											X							X		
	Camping Ground/RV Park											X							X		
	Public Education/Nature Center				X							X							X		

Table 10-1. Alternatives Evaluation and Comparison Framework, Page 4

11 Regional Financial Plan

11.1 Regional Economic Profile

11.1.1 Counties in the Flood Region

The Feather River Region includes portions of the counties of Sutter, Butte, and Yuba (“Flood Region Counties”).² Predominantly rural in nature, these counties have economies largely driven by agriculture and state/federal agency activities. As shown in **Table 11-1** these counties account for only about one percent of the state’s entire population and households, and carry overall population densities that are about half of California’s average density of 246 people per mile.

Table 11-1. Population/Household Overview (2013)

Area	Population (2013)		Households (2013)		Population Density	
	Number	%	Number	%	Per Sq. Mile	%
State of California	37,966,471		12,552,658		246	
Flood Region Counties		<i>of Region</i>		<i>of Region</i>		<i>of Region</i>
Butte County	221,485	57%	85,388	60%	134	99%
Sutter County	95,851	25%	31,259	22%	158	117%
Yuba County	73,439	19%	24,842	18%	116	86%
		<i>of CA</i>		<i>of CA</i>		<i>of CA</i>
Total	390,775	1%	141,489	1%	135	55%

Sources: California Department of Finance-Demographic Research Unit 2013 (Jan 1, 2013 estimates), Yuba-Sutter Comprehensive Economic Development Strategy, 2013, and 2007 Citi-Data.com

The Flood Region Counties are marked by a high concentration of agricultural activities. Together, the three counties produce significant amounts of rice, walnuts, almonds, dried plums/prunes, and peaches (**Table 11-2**). In addition, the Flood Region Counties provide approximately 500,000 acres of dry and irrigated pastureland³.

Table 11-2. Top Harvested Crops, 2012

Item	Yuba, Sutter, & Butte Counties Amount
Top Crops	<i>Acres</i>
Rice	247,601
Walnuts	75,590
Almonds	40,616
Dried Plums/Prunes	32,835
Peaches	12,833
Tomatoes	7,827
Kiwifruit	319
Top Crops	<i>Value per Acre</i>
Kiwifruit	\$9,165
Walnuts	\$5,242
Peaches	\$4,884
Dried Plums/Prunes	\$3,387
Almonds	\$3,308
Rice	\$1,523
Tomatoes (processing)	\$2,725

Sources: 2012 Butte, Yuba, Sutter County Crop Reports, California Agricultural Statistics Service

Government entities and agriculture-related companies are the dominant large employers in Flood Region Counties. Large public employers include local, state, and federal agencies, including the military, while ag-related companies comprise a combination of businesses that produce, harvest, package, ship, and/or deliver agricultural goods (**Table 11-3**). Employment patterns in the Flood Region can be understood by evaluating the concentration of jobs by sector as compared to California as a whole. For purposes of economic development, a concentration level of 1.20 or greater generally indicates that a region is “specialized” in that particular sector, a level of 0.80 to 1.20 suggests that the region’s level is commensurate with the statewide average for that sector, and a level of 0.80 or less suggests that a region may have insufficient levels in the sector. The agriculture and government industries as a whole have much higher concentrations of employment and businesses compared to the statewide economy (**Table 11-4**).

² A very small portion of the Flood Region is located within Placer County; however, there are no identified communities within this area. Therefore, Placer County is not included in the Economic Profile of the Flood Region.

³ California Ag Statistics, 2012. Reflects Butte, Sutter, and Yuba County totals.

Table 11-3. Major Employers (Flood Region Counties)

	Yuba County		Sutter County		Butte County	
	Employer	Empl.	Employer	Empl.	Employer	Empl.
1	Beale Air Force Base	5,797	Yuba City Unif. School Dist.	1,320	Calif. State Univ., Chico	1,000-4,999
2	Marysville Jt. Unif. Sch. Dist.	1,200	Sutter County	865	Enloe Medical Center	1,700
3	Freemont-Rideout Health Gr.	1,191	Sunsweet Growers, Inc.	814	Pacific Coast Producers	1,200
4	County of Yuba	878	Freemont-Rideout Health Gr.	523	Feather River Hospital	500-999
5	California Dept. of Transp.	800	Walmart	480	Lifetouch	500-999
6	Walmart	420	Sysco Food Service of Sac.	352	Lodge at Feather Falls	500-999
7	Bishop's Pumpkin Farm	310	City of Yuba City	275	Sierra Nevada Brewing Co.	500-999
8	Yuba Comm. College Dist.	300	Pacific Gas & Electric	206	YRC Transp./Freight	500-999
9	Naumes, Inc.	240	Legend Transportation	200	Behavioral Health Dept.	250-499
10	Recology Yuba-Sutter	151	Raley's/Bel Air Markets	182	Bettendorf Trucking	250-499
11	Pacific Gas & Electric	135	WinCo	150	Build.com	250-499
12	Appeal Democrat	118	Valley Fine Foods	131	Rabobank	250-499
13	Peach Tree Healthcare	117	Deluxe Packages	73	Butte Comm. Insurance	250-499
14	Elite Universal Security	75	Orchard Machinery Corp.	67	Butte Co. Social Welfare	250-499
15	Nordic Industries	50	Valley Farm Transport	64	County Sheriff-Oroville	325
16	Frank M. Booth, Inc.	43	Holt of California	25	Walmart	250-499

Bold signifies agricultural-related business, including some indirect business (such as hauling).

Sources: Butte County Economic Dev. Corp., CED 2011/12 Yuba-Sutter Economic Dev. Corp., <http://butte-edc.com/top-employers/>

Table 11-4. Employment by Industry, Flood Counties

Item	Flood Counties [1]		State of California		Flood Counties Concentration Level
	Number	% Total	Number	% Total	
Total Jobs, 2010 (in thousands)	166.73	100.0%	19,711.24	100.0%	
Farm Employment	6.76	4.1%	210.65	1.1%	3.8
Other Private Sector Jobs	120.73	79.1%	15,497.81	85.8%	0.9
Federal Civilian and Military Govt	5.66	3.4%	457.49	2.3%	1.5
State & Local Govt	22.4	13.4%	2,125.96	10.8%	1.2
Total [2]	166.71	100.0%	19,711.26	100.0%	NA
Private Non-Farm Estab. by Size, 2009					
Total No. of Business Establishments	7,401	100.0%	857,826	100.0%	
Ag. Services, Forestry, Fishing & Hunting	58	0.8%	1,877	0.2%	6.3
Other & Unclassified Establishments	25	0.3%	2,239	0.3%	1.3
Total	7,402	100.0%	857,826	100.0%	NA

[1] Includes Sutter County, Yuba County, and Butte County.
 [2] Totals may not match first line totals because of data rounding.
 Sources: Woods & Poole Economics 2012 State Profile

11.1.2 Flood Region Specific Characteristics

As shown in Figure 1-1, the Flood Region itself includes only portions of Flood Region Counties. As shown in **Table 11-5**, much of the land in Flood Region is dedicated to farmland and grazing. This table provides a breakdown of the Flood Region’s assessable land based upon Yuba, Sutter, Butte and Placer County Assessor data. The breakdown describes the use of the land available to potentially provide funding for future infrastructure. This land use breakdown is distinct from the land use makeup of the Region as a whole as the breakdown excludes much area of the Region that does not appear on County Assessor rolls and would likely generate little or no value in terms of its ability to fund infrastructure improvements.

Table 11-5. Land Consumption Patterns of Assessed Acres

Item	Flood Region	
	Acres	% of Total
Residential	56,000	20.4%
Industrial	2,300	0.8%
Rural/Agriculture	202,900	73.9%
Utilities/Transportation	600	0.2%
Commercial	2,300	0.8%
Governmental	10,300	3.8%
Total	274,400	

Sources: GEI GIS data, County GIS Data, Parcel Quest / Assessor Use Codes and land use classification by Larsen Wurzel & Associates.

There are five urbanized/urbanizing areas within the Flood Region: Yuba City, Linda, Olivehurst, Marysville and Live Oak, which, combined, account for roughly three-fourths of total Flood Region population and households. Other smaller rural communities include Gridley, Tierra Buena, Biggs, Rio Oso, Nicolaus, and Wheatland, as shown in **Table 11-6**.

Table 11-6. Flood Region Population/Household Overview (2013)

Area	Population (2013)		Households (2013)	
	Number	%	Number	%
Flood Region	160,645	100.0%	52,637	100.0%
Urbanized/Urbanizing Areas within Flood Region				
Yuba City	65,841	41.0%	21,602	41.0%
Linda [1]	17,773	11.1%	6,084	11.6%
Olivehurst [1]	13,656	8.5%	4,887	9.3%
Marysville	12,250	7.6%	4,680	8.9%
Live Oak	8,392	5.2%	2,378	4.5%
Total	117,912	73.4%	39,631	75.3%
Other Rural Communities				
Gridley [2]	6,723	4.2%	2,265	4.3%
Tierra Buena [3] [2]	5,302	3.3%	1,786	3.4%
Wheatland	3,493	2.2%	1,217	2.3%
Biggs[2]	1,692	1.1%	570	1.1%
Rio Oso [1]	356	0.2%	140	0.3%
Nicolaus [1]	211	0.1%	101	0.2%
Total	17,777	11.1%	6,079	11.5%
[1] Reflects 2010 data for the Census Designated Place. From Yuba-Sutter CEDS.				
[2] Reflects an estimated number of households based on 3.0 persons per household, the average density for all other communities within the Region.				
[3] Reflects 2007 data.				

Based on data specific to the boundaries of the Flood Region, **Tables 11-7 through 11-9** provide additional insight into the demographic and economic trends specific to the Flood Region.

Table 11-7 provides a summary of recent economic data available at the State and Flood Region specific level.

Table 11-7. Key Economic Characteristics: Flood Region

Item	STATE		SACRAMENTO REGION		FLOOD REGION	
Economic Indicators						
Unempl. Rate (Dec 2013)	8.30%	EDD	7.60%	EDD	10.8%	2013 (Claritas/DWR)
Median Household Income	\$58,328	2012 (ACS 1- Yr)	\$56,083	2012 (ACS 1-Yr)	\$44,523	2013 (Claritas/DWR)
Median Home Price	\$360,000	DQNews 2013	\$276,000	DQ 2013	\$207,100	DQNews 2013
Commercial Rent Per Sq. Ft.					<i>(Yuba City)</i>	
Industrial	NA	NA	\$0.40	Colliers 3Q 2013	\$0.35	Loopnet, Jan 2014
Retail	NA	NA	\$1.38	Colliers 3Q 2013	\$0.75-1.70	Loopnet, Jan 2014
Office	NA	NA	\$1.65	Colliers 3Q 2013	\$1.00	Loopnet, Jan 2014
<i>Sources: American Factfinder, Claritas/DWR, California Economic Development Department and/or Woods & Poole, DataQuick, Colliers International, and Loopnet.</i>						

Compared to California and the Sacramento Region, the Flood Region exhibits higher unemployment rates, lower household incomes, and lower home prices. One specific highlight within the Flood Region includes the Unemployment Rate in Yuba City, CA at 13.8% (Ca EDD, December, 2013). Further, commercial market rents, primarily tracked by major brokerage entities, also appear to be a bit lower than the Sacramento Region, which enjoys a larger and more diverse set of economic activity.

Furthermore, the Flood Region contains pockets of areas classified as Disadvantaged Communities (areas with a Median Income at 80% or below the Statewide Median Income as of 2010 Census data). These areas include the communities of Marysville, Live Oak, Linda, Olivehurst, Gridley, and East Nicolaus. These areas, shown in **Table 11-8**, would be eligible, under current funding criteria, for higher State cost sharing under certain funding programs funded by Propositions 1E and 84.

Table 11-8. Disadvantaged Communities within the Flood Region

Community	Households	Median Household Income	MHI as % of California MHI
California	12,552,658	\$58,328	
Sutter County	85,388	\$47,081	80.7%
Butte County	31,259	\$40,960	70.2%
Yuba County	24,842	\$43,545	74.7%
Total Flood Region Counties [1]	141,489	\$45,108	77.3%
Disadvantaged Community			
East Nicolaus	112	\$37,500	64.3%
Gridley	2,033	\$37,358	64.0%
Live Oak	2,433	\$42,069	72.1%
Olivehurst	4,079	\$37,096	63.6%
Marysville	4,529	\$37,858	64.9%
Linda	5,468	\$34,710	59.5%
[1] Weighted Average Median Household Income			
Sources: DWR Disadvantaged Community Mapping Tool (http://www.water.ca.gov/irwm/grants/resourceslinks.cfm) accessed 01-08-2014. U.S. Census Bureau, 2012 American Community Survey.			

11.1.3 Future Growth Prospects

The California State Department of Finance projects that the state’s population will grow, on average, by less than 1 percent annually through 2020 and 2035. While the same level of demographic and employment data is not available at a sub-county level, projected growth within the Flood Region by the regional metropolitan planning organizations,⁴ Woods and Poole, and the California Department of Finance provide insight into the potential level of growth anticipated by those organizations for their planning purposes. **Table 11-9** summarizes that the Flood Region is anticipated to grow by nearly 37,000 new housing units, (1.86% percent annually) and by more than 30,000 jobs (1.85% annually) by 2040, nearly double the anticipated statewide growth rate. This growth is based on projections from the COGs through 2035 and extended by five years to reach 2040.

These indicators provide an insight into the expected demand for new housing and commercial development. While new development creates new impacts associated with the demand for flood risk mitigation, (by virtue of increases the consequences of a flood), new residential and commercial development could also provide additional resources to fund future improvements and services.

Table 11-9. Potential Growth (Through 2040)

Item	Flood Region	
	Residential Units	Jobs
Year: 2013	57,313	46,025
Year: 2035	85,731	67,396
Resulting Avg. Annual Growth Rate	1.85%	1.95%
Projected: 2040	93,948	74,242
Growth: 2013 - 2040	36,635	28,217
Sources: City/County General Plans, Metropolitan Planning Organizations		

11.1.3.1 Housing Growth

Of new housing development in the Flood Region through 2020 and 2040, 75 to 80 percent is expected to occur in Yuba City, unincorporated areas of Yuba County, (including “Established Communities” of Linda and Olivehurst as well as “Developing Communities” of Plumas Lakes, East Linda, and North Arboga), and the City of Gridley in Butte County. Gridley and developing communities in Yuba County are forecasted to experience the most rapid rates of growth, doubling their housing units by 2040. **Table 11-10** contains a list of known proposed and planned projects in the Flood Region, with their corresponding land use plans and development status. These projects serve to illustrate the scale of new development that could potentially occur within the next real estate cycle; however, many additional projects would need to be developed to achieve the growth projections envisioned for these communities.

⁴ The Yuba, Sutter and Placer County portions of the Flood Region lie within the Sacramento Area Council of Governments (SACOG), the Butte County portion lies within Butte County Association of Governments (BCAG).

Table 11-10. Select Approved, Proposed, and Planned Projects in the Flood Region

Jurisdiction (Flood Region Boundaries Only)	Residential Units	Commercial Acres	
		BP/Ind	Commercial
Yuba City [1]			
East Lincoln Specific Plan (Approved)	4,865	0	34
Other Approved but Not Yet Built Projects [1]	777	0	0
Proposed Projects [1]	383	68	51
Total Yuba City	6,025	68	85
Yuba County: Plumas Lake / North Arboga Rem. Dev. [2]	8,000	N/A	60
City of Wheatland: Proposed Annexation Projects [3]	1,609	0	12
Live Oak: Approved but Not Yet Built Projects [4]	673	0	0
City of Gridley: Approved but Not Yet Built Projects [5]	171	NA	NA
Sutter County (unincorporated areas) [6]	0	0	0
Butte County (unincorporated areas) [6]	0	0	0
TOTAL MAJOR IDENTIFIED PROJECTS	16,478	68	156
[1] Based on information provided by Yuba City Planning Dept, January 2014. Projects include the Harter Specific Plan and a variety of other smaller projects.			
[2] Source: Three Rivers Levee Fee Revised October 13, 2008 with estimated adjustments made by LWA for development between 2008 and 2012.			
[3] Reflects a rough estimate of the portion of the proposed Nichols Grove project located within the Flood Region boundaries.			
[4] Reflects remaining units in current subdivisions within a variety of projects approved 2005 - 2008.			
[5] Includes Heron Landing, Eagle Meadows, Steffan Estates, Elder Estates, and Moss PM.			
[6] No major projects identified within Flood Region boundaries.			
Sources: Yuba City Planning Dept, Yuba County Planning Dept, Gridley Planning Dept, Live Oak Planning Dept., New Economics & Advisory, and LWA.			

Future housing development in these areas can be characterized by the following dynamics:

- Yuba City’s existing housing stock is fairly diverse, with only about 55% detached, single-family homes. Within the existing city limits, vacant land is primarily zoned for low-density development, which averages less than 8 units per acre⁵. But, at least one approved project within the City’s Sphere Of Influence, the East Lincoln Specific Plan, includes nearly 2,800 units with an average density of 15 units per acre.
- Unincorporated areas of Yuba County have predominantly detached single-family homes (nearly 70% in 2008). The County’s 2030 General Plan anticipates continued emphasis on low-density development, with projections for 18,800-25,000 new single-family units and only 3,400-4,700 multifamily units within the Linda, Olivehurst, and Plumas Lake communities⁶.
- The City of Gridley, in Butte County, is expecting to accommodate nearly 3,000 new units within its policy area by 2030. 55-60 percent would be single-family units averaging densities of 8 units per acre or less; the remainder would be multifamily units ranging from 9 units per acre to 30 units per acre.⁷ However, at this time, Gridley has only a small stock of remaining units to complete approved subdivisions; beyond these units, no new major projects have been identified to accommodate the estimated growth.
- The City of Wheatland, according to SACOG, is not projected to grow significantly through 2035. However, the City is pursuing significant levels of growth and is actively entitling thousands of residential units and significant accompanying commercial development. These units are not included in the growth projections shown in **Table 11-10** because the majority of this development is located immediately beyond the Flood Region boundaries, and the likelihood of development within the boundaries is unknown at this time.

11.1.3.2 Employment Growth

Approximately 80 percent of Flood Region job growth is expected to occur within Yuba City, Beale Air Force Base, and unincorporated Developing Communities in Yuba County, (including Plumas Lakes, East Linda, and North Arboga). Future commercial development in these areas can be characterized as follows:

- Yuba City is targeting ag-related processing and equipment manufacturing, medical/health industries, and professional services and office users. These types of uses would likely generate additional demand for industrial and office space. Call centers may also be a viable option. In addition, development along Route 99 and Route 20 would likely appeal to regional retail and consumer services.⁸
- The unincorporated Yuba County communities of Plumas Lakes, the North Arboga Study Area, and East Linda are expected to add nearly 18,000 jobs by 2035. Yuba County’s existing economic development strategies emphasize the support of agriculture. Priority strategies include both promoting new commercial and industrial development to accommodate process and manufacturing opportunities for local agricultural commodities and developing alternative and multimodal distribution infrastructure to complement existing rail and truck transportation methods.⁹ Within the unincorporated communities, new jobs would be accommodated within traditional office buildings and business parks designed to accommodate manufacturing

⁵ Yuba City Housing Element, 2008, pages 39-43.

⁶ Yuba County 2030 General Plan, Community Development Chapter, page 20.

⁷ City of Gridley 2030 General Plan, Land Use Element, page 10.

⁸ Yuba City General Plan, 2004, Section 2-8.

⁹ 2013-2014 Comprehensive Economic Development Strategy (CEDS) for Yuba-Sutter, page 23.

and warehouses¹⁰. New retail establishments would also create jobs serving residential development within these developing areas.

Beale Air Force Base, the single largest employer north of Sacramento until the Oregon border, is also expected to continue to add jobs through 2035. Because these jobs will occur on the existing base, they are not expected to generate demand for additional commercial development. However, base activities tend to have an indirect impact on employment, and Yuba County is prioritizing road access improvements to and from the base to facilitate additional growth both on and off base.¹¹

11.1.4 Regional Economic Profile Findings

- **Finding 1: Flood Region Counties are primarily characterized by their rural setting and agricultural economy.** Compared to the state as a whole, Sutter, Yuba, and Butte counties have low population densities and an economy largely driven by agricultural and government activities. Major agricultural crops include milling rice, peaches, and prunes, as well as nuts; pasture is also an important use of land in these counties. Agricultural companies comprise a combination of businesses that produce, harvest, package, ship, and/or deliver agricultural goods. Major public entities include Beale Air Force Base, California State University Chico, Caltrans, and a host of other local agencies.
- **Finding 2: The Flood Region itself is marked by relatively low household incomes and home prices, low commercial rental rates, and high unemployment rates compared to California and the nearby overall Sacramento Region.** Multiple areas classified as Disadvantaged Communities would be eligible, under current funding criteria, for higher State cost sharing under certain funding programs funded by Propositions 1E and 84.
- **Finding 3: Despite the anticipation for rapid growth rates, the Flood Region is nonetheless expected to experience modest growth overall over the next 25 years, with more than 75 percent of growth occurring in Yuba City, unincorporated communities in Yuba County along Highway 70, Beale Air Force Base, and the City of Gridley.** The majority of housing growth is expected to take the form of low-density, single-family detached homes. Jurisdictions with the largest concentrations of anticipated employment growth are targeting agriculture, medical/health, professional services, military, and retail industries. Except for military jobs, industry growth will likely lead to the development of additional industrial, office, and retail space within the Flood Region.

11.2 Funding

In general, funding for Flood Risk Management efforts comes from three sources; federal, state and local governments. California's Flood Future report (and associated Attachment I: Finance Strategies) provides an excellent overview and description of the general funding regime currently being utilized to enhance California's flood system. The Attachment also identifies and describes many of the funding and financing mechanisms available to local agencies to fund flood control infrastructure and services.

Within the Feather River Region, significant investments from federal, state and local sources have recently been made and are currently underway. The following provides a general overview of the current flood control funding sources within the flood region.

11.2.1 Federal Funding

The USACE has current ongoing and recently completed studies of flood risk and potential improvements in the Area. These study efforts could ultimately lead to additional federal funding or crediting for locally advanced and completed flood risk reduction improvements, however, the process for garnering federal funding for flood risk reduction projects requires that a federal interest in the project be identified. Federal interest has generally been identified and evaluated within feasibility studies prepared by the USACE that evaluate various criteria and generally emphasize the flood damage-reduction benefits associated with a specific project. This approach to defining economic benefits is narrow in focus and favors highly urbanized areas with existing infrastructure. This approach may not signal a significant federal interest in many of the projects identified in the region due to the large amount of agricultural land, the relatively small size of incorporated cities as compared to other areas competing for the same resources, and the number of very small rural community landscapes that predominantly define the region.

Given the constraints of the current approach for evaluating and garnering federal investment for projects coupled with waning federal budgets and forecasted expenditures, there is not likely to be significant additional federal investment in the Region in the near term. Furthermore, the formulation, evaluation, authorization and appropriation process for projects is protracted, expensive and ultimately leads to higher project costs that may, in some cases, not be in the best economic interest of local project proponents. As a result, funding and financing plans for the projects identified within this plan do not rely heavily on future federal investment.

11.2.2 State Funding

11.2.2.1 Current & Future State Funding

In the near term, the State plans to utilize the remaining Proposition 1E bond funds authorized through June 2016 for projects identified within the Central Valley. Within the CVFPP, the State has identified that these remaining bond funds are well short of the identified need for investment in the flood risk reduction within the Central Valley,¹² and that additional bond authorizations will be needed.¹³ As part of ongoing CVFPP planning process, over the next few years, the State will be identifying how it will address the future role it will play in securing funding for identified improvements and developing a sustainable funding source to meet the long term demands for flood control infrastructure. The State Legislature and Governor will need to play a significant role with respect to how State and local funding can be generated within the region as it proposes and considers legislation associated with planned updates to the CVFPP and future financing/funding plan recommendations.

¹⁰ Plumas Lakes Specific Plan, East Linda Specific Plan.

¹¹ 2013-204 Comprehensive Economic Development Strategy (CEDS) for Yuba-Sutter, page 19.

¹² The CVFPP identified costs to implement the State Systemwide Investment Approach between \$14 to \$17 Billion. The California's Flood Futures Report identified costs to upwards of \$50 billion statewide.

¹³ 2012 Central Valley Flood Protection Plan, Page 4-38 to 4-40.

Current State efforts to generate additional funding include a water General Obligation bond package on the November 2014 ballot. Currently the legislature is considering no less than 10 bills that would modify that package. However these current efforts provide only a relatively small amount of funding for flood control efforts.

Other policy efforts that could generate future State funding include the recommendations presented within the Governor’s Water Action Plan. These recommendations include providing support and expanding funding for Integrated Water Management Planning and Projects, providing assistance to disadvantaged communities, prioritizing funding to reduce flood risk and improve flood response. In addition to recommendations that could direct state funding to the region, the Governor’s Water Action Plan also identified recommendations that could make it easier to generate local funding including removing barriers to local and regional funding for water projects.

The Department of Water Resources is in the process of programming the available remaining Proposition 1E Bond fund post adoption of the CVFPP. **Tables 11-11** and **11-12** provides an overview of the programs that have been, are currently ongoing and expected to be available to local agencies to assist within funding the projects and programs identified within this RFMP.

Table 11-11. State Funding Programs - DWR

Program Name	Program Summary	Status	Type	Who is Eligible to Apply	Max/ Min Award Amounts/ Cost Share Range
<u>Early Implementation Program (EIP)</u>	Fund "ready," no regrets Projects for State Plan of Flood Control Facilities in Urban areas in advance of adoption of the Central Valley Flood Protection Plan. These funds will be for: (a) repair, rehabilitation, reconstruction or replacement of levees, weirs, bypasses and facilities of the State Plan of Flood Control and (b) improving or adding facilities to the State Plan of Flood Control to increase levels of flood protection for Urban Areas.	Phasing Out	Grant	Eligible applications are local public agencies or Joint Powers Authority	\$200 million max per project. / 50% to 90%
<u>Flood Corridor Program</u>	This statewide program funds multi-objective, flood risk reduction projects that protect and restore floodplains and preserve or enhance wildlife habitat and agriculture. The program funds primarily non-structural projects, including acquiring and conserving floodplains, removing structures and precluding development in flood prone areas, and constructing earthen detention basins, along with restoring habitat and protecting agricultural land. Setback levees are also included when they enable a more naturally functioning floodplain. Flood Corridor Program includes three flood protection grant programs: <ul style="list-style-type: none"> • Flood Protection Corridor Program (Propositions 13 and 84); • Floodway Corridor Program (Proposition 1E); and • Central Valley Nonstructural Grants Program (Proposition 1E). 	Ongoing	Grant	Local public agencies (county, city, district or joint powers authority), nonprofit organizations, California Native American Tribes registered as a nonprofit organization or partner of a nonprofit or local public agency. Also, direct expenditure funding to other government agencies (local, State, or federal), nonprofit organizations, or contractors for projects proposed by DWR that are in the State’s interest to fulfill program goals.	Maximum - \$5 million No minimum / TBD
<u>USACE/CVFPB Projects</u>	Cost share with USACE on SPFC USACE projects	Ongoing	Project Cooperation Agreement (PCA) or Project Partnership Agreement (PPA)	CVFPB with a local Sponsor	NA
<u>USACE/CVFPB Studies</u>	Cost share with USACE on SPFC USACE studies	Ongoing	Project Cooperation Agreement (PCA) or Project Partnership Agreement (PPA)	CVFPB with a local Sponsor	NA
<u>Yuba Feather Flood Protection Program (YFFPP)</u>	The Yuba Feather Flood Protection Program provides financial assistance to local flood agencies to perform feasibility studies, design and implement feasible flood protection projects within the YFFPP jurisdiction.	Phasing Out	Grant	Local public agencies (county, city, district or joint powers authority) that have legal authority and jurisdiction to implement a flood control program along the Yuba and Feather Rivers and their tributaries or along the Colusa Basin Drain and their tributaries (per section 79068.6- Proposition 13).	Limited to the total fund made available per Proposal Solicitation Package. No specific limitation stated per project.
<u>Small Community Flood Risk Reduction (SCFRR)</u>	Projects to reduce flood risk in small, rural, and agricultural communities in the Central Valley. Funds support non-routine O&M, O&M plan updates, evaluations, feasibility studies, design, and construction of proactive repairs to flood control facilities of the SPFC and appurtenant non-project levees.	Future	Grant	Local agencies: evaluate SPFC facilities must protect small and rural communities in the Central Valley designated by the CVFPP to have a High or Moderate-High Flood Threat Level.	\$2 million max for evaluations and feasibility studies. \$5 million max for implementation or design projects. / 50 to 90%

Program Name	Program Summary	Status	Type	Who is Eligible to Apply	Max/ Min Award Amounts/ Cost Share Range
<u>System wide Flood Risk Reduction (SWFRR)</u>	Implement recommendations of Basin-wide Feasibility Studies	Future	Grant	Eligible applications are local public agencies or Joint Powers Authority	N/A / Up to 100%
<u>Urban Flood Risk Reduction (UFRR)</u>	Levee repair or improvement projects within the Central Valley that are located within the urban area and are State Plan of Flood Control facilities.	Future	Grant	Eligible applications are local public agencies or Joint Powers Authority	\$200 million max per project. / 50 to 90%
<u>Flood System Repair Projects (FSRP)</u>	Evaluate (feasibility), design, and construct repairs of non-urban SPFC Facility (levees, channels, structures, etc.) deficiencies	Starting Up	Grant	Eligible applications are local public agencies or Joint Powers Authority	\$5,000,000 per project, 50 to 90%
<u>Flood ER - Forecast Coordinated Operations</u>	To further participation of reservoir operators (affecting CV) in the F-CO program, especially in obtaining necessary decision support system tools & equipment and field measuring equipment.	Ongoing	Grant	Federal agencies, State agencies or California Local Public agencies with responsibility for operating a reservoir that has a flood control reservation pool and is willing to participate in the Forecast-Coordinated Operations program and willing to coordinate its reservoir releases with other reservoir operators in the river system during flood events.	Not Specified
<u>Flood ER - Statewide ER Grants</u>	Provide support for local EAP's or related Flood preparedness and response activities. Funding is available for material acquisition such as emergency communications equipment to improve emergency response preparedness, and program enhancement activities that improve emergency response.	Awarded	Grant	California public agencies with primary responsibility for flood emergency response and coordination. "Primary responsibility for flood emergency response and coordination" applies only to counties, cities, flood control districts, reclamation districts and local maintaining agencies in California. The geographic scope of this grant is statewide with the exception of the legal Delta.	N/A
<u>Central Valley Flood System Conservation-Framework and Strategy</u>	The program funds planning and implementation of projects in support of the Central Valley Flood System Conservation Framework and the Conservation Strategy. The projects will incorporate environmental stewardship and sustainability principles into State Plan of Flood Control flood management activities.	Awarded	Grant	Federal, State and Local public agencies; private mitigation banks, Non-profits (501(c)(3))	\$5 million
<u>Integrated Regional Water Management (IRWM)</u>	Grant funds for development and revisions of IRWM Plans, and implementation of projects in IRWM Plans. Goals of Projects: to assist local public agencies to meet long-term water management needs of the State, including the delivery of safe drinking water, flood risk reduction, and protection of water quality and the environment.	Ongoing	Grant	Applicant must be a local public agency or nonprofit representing an accepted IRWM Region. Other IRWM partners may access funds through their own agreements with the applicant/grantee.	Bond funding allocation for entire program is \$1billion Prop 84 allots grant funding to 11 funding areas. Guidelines contain information on how potential funding of multiple IRWM efforts within a funding area will occur and maximum grant amount per funding area. Guidelines have been combined with Prop 1E SWFM funding. Each Proposal Solicitation Package will have predetermined amount of funds available.
<u>Urban Streams Restoration Program</u>	Program provides grants for stream restoration projects that reduce flooding or erosion and associated property damages; restore, enhance, or protect the natural environment; and promote community involvement, education, and stewardship in urban streams.	Ongoing	Grant	Combined sponsorship between Local government agencies and citizens groups/nonprofits	\$1 million per eligible project

Table 11-12. State Funding Programs – Other Agencies

Agency	Program Name	Program Summary	Who is Eligible to Apply	Cost Share Range
State-California Natural Resource Agency	California River Parkway Program (CRPP)	<p>The Proposition 50 California River Parkway Grant Program in the Resources Agency is a competitive grant program for river parkways projects. Eligible projects must provide public access or be a component of a larger parkway plan that provides public access. In addition, projects must meet two of the following conditions:</p> <ul style="list-style-type: none"> Provide compatible recreational opportunities including trails for strolling, hiking, bicycling, and equestrian uses along rivers and streams. Protect, improve, or restore riverine or riparian habitat, including benefits to wildlife habitat and water quality. Maintain or restore the open-space character of lands along rivers and streams so that they are compatible with periodic flooding as part of a flood management plan or project. Convert existing developed riverfront land into uses consistent with river parkways. Provide facilities to support or interpret river or stream restoration or other conservation activities. 	Public Agencies and California Nonprofit Organizations	TBD
State – Wildlife Conservation Board	Habitat Enhancement and Restoration Program	<p>General restoration program that includes native fisheries restoration, restoration of wetlands that fall outside the jurisdiction of the Inland Wetland Conservation Program such as coastal, tidal, or fresh water habitats, other native habitat restoration projects including coastal scrub, grasslands, and threatened and endangered species habitats, in-stream restoration projects including removal of fish passage barriers and other obstructions, and other projects that improve native habitat quality within the State.</p> <p>Eligible projects that are approved and funded must provide for the long-term maintenance of the project once completed.</p> <p>Projects must receive a recommendation from the California Department of Fish and Wildlife. Projects may be located on CDFW lands, or other public or private lands.</p>	For projects to restore and enhance wildlife habitats, the WCB is authorized to award grants to nonprofit organizations [501(c)(3)], local governmental agencies, State departments and federal agencies.	N/A – Ongoing solicitation based on available funding.
State – Wildlife Conservation Board	Public Access Development Program	<p>Development of facilities in cooperation with local agencies for public access to hunting, fishing, or other wildlife-oriented recreation. Financial assistance is available to cities, counties and public districts or corporations for development such as fishing piers or floats, access roads, boat launching ramps, trails, boardwalks, interpretive facilities, and lake or stream improvements. Support facilities such as restrooms and parking areas are also eligible for funding under this program.</p> <p>Under the Wildlife Conservation Law of 1947, it is required that the State have a proprietary interest in the land or water on which the improvements are made. Prior to approval of a project by the WCB, either a Notice of Unrecorded Grant Agreement or a lease agreement may be required between the local agency and the State, to secure a proprietary interest in the project site and ensure the long-term management and maintenance of the improvements. In almost all cases this will be for a period of at least 25 years. In some cases federal funds may also be used, and under these circumstances, a perpetual interest may be required.</p>	Cities, counties and public districts or corporations	N/A – Ongoing solicitation based on available funding.

11.2.3 Local Funding

11.2.3.1 General Discussion of Funding & Sources

The Cities, Counties, Local Maintaining Agencies and the regional flood control agencies within the Region all have played a significant part in funding the local share of flood control improvements and operations and maintenance. Funding by local agencies within the region is limited due to constitutional and statutory constraints to the way local governments can fund and finance capital improvements and services. . After 2016, YCWA will have power generation revenues from its Yuba River Development Project as a source of funding to support local flood control agencies needs for funding flood control projects. As noted previously, Attachment I to California’s Flood Future Report provides a detailed description of funding mechanisms available to local agencies to fund flood control improvements.

In general, revenues for flood control within the Region are generated from property based taxes, fees and assessments. In California, a local agency's ability to provide ongoing services and invest in its infrastructure is limited by voter-approved initiatives, such as Proposition 13 (1978) (limiting property tax increases), Proposition 218 (1996) (requiring voter approval for new assessments), and Proposition 26 (2010) (redefining many fees as taxes). The impacts of institutional and legal constraints associated with raising local funding for flood infrastructure and services is described in great detail in the Public Policy Institute of California's report, "*Paying for Water in California*" March 2014. The following **Table 11-13** provides a summary of the local funding methods used by many agencies in California and the Region to fund flood control improvements and services.¹⁴ The table describes the general uses of the funding source and the attributes and applicability of the mechanism for flood control. In addition to these sources, many local agencies supplement funding for flood work specifically through enterprise revenues related to storm water management and general fund revenues.

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¹⁴ California's Flood Future: Recommendations for Managing the State's Flood Risk, Attachment I: Finance Strategies, Page I-43.

Table 11-13a. Summary of Potential Local Funding Mechanisms

Item	Funding Attribute						Pro/Con		Note
	Use	Voter Approval	Benefit Test	Bonds Allowed	Funding Period	Entity	Pro	Con	
Enterprise Revenues									
Utility User Fees/Taxes	O&M/ Capital Improvements	50% by Property Assessed	Yes	Yes	Long-Term	Varies	Would be broad based applying to all parcels. Depending upon service provided, could be exempt from Prop 218 balloting process. (Solely flood control would not apply.)	Might require enabling legislation for the specific district. Prop 218 would apply.	
Sales Tax Measure	O&M/ Capital Improvements as Approved	2/3	No	Yes	As Authorized	Cities or Counties	Flexible if approved.	Difficult to approve and limited to amount over Statewide sales tax rate.	
Assessment Districts [1]									
Various Water Code Sections	O&M/ Capital Improvements	50% by Property Assessed	Yes	No	Long-Term	Reclamation & Levee Districts	Simple Majority Approval, Ongoing Funding Source	Applicability of Prop 218 - Must Show Benefit	Used to fund maintenance or capital works. Through other authority, can be used to finance improvements.
Benefit Assessment District Act of 1982	O&M/ Capital Improvements	50% of Property Assessed	Yes	No	Long-Term	Flexible	Simple Majority Approval, Ongoing Funding Source	Must Show Benefit Improvements/Services must be within the Boundary	Could provide some reimbursement of Advance Funding
Municipal Improvement District Act of 1913/1915	Capital Improvements	50% of Property Assessed	Yes	Yes	Long-Term	Flexible	Simple Majority Approval, Ongoing Funding Source	Must Show Benefit Improvements/Services must be within the Boundary	Could provide some reimbursement of Advance Funding
Geological Hazard Abatement Districts (GHAD)	O&M/ Capital Improvements	50% of Property Assessed	Yes	Yes	Long-Term	Independent District	Broad scope of works, locally autonomous, Simple Majority Approval, Ongoing Funding Source. Certain exemptions from review under CEQA apply.	Must prepare Plan of Control. Creates new independent entity with organizational responsibility (similar to JPA), Prop 218 applies with respect to assessments levied.	As independent entity could be alternative to JPA. Can fund reserves.

Item	Funding Attribute						Pro/Con		Note
	Use	Voter Approval	Benefit Test	Bonds Allowed	Funding Period	Entity	Pro	Con	
Community Facilities Districts [1]	O&M/ Capital Improvements	2/3's (See Note)	No	Yes	Long-Term	Flexible	Benefit not Needed, Flexible in Forming District, Improvements located anywhere	2/3 Approval Difficult to Obtain	Voting requirements change depending on presence of registered voters within boundary.
Development Impact Fees	Capital Improvements	NA	Yes	NA	Long-Term	County & City (Land Use Agencies)	Implemented by Agency Action in Short Time Period	-Must Show Benefit -Development Feasibility Issues -Only works if area of flood control Benefit is slated for Development	Could provide some reimbursement of Advance Funding
Advance Funding [2]	Planning & Capital Improvements	NA	NA	No	Short-Term	N/A	Can cover upfront planning/operations costs	Limited/Uncertain Availability	Could be subject to reimbursement from various sources over time.

Source: California Flood Future's Report - Attachment I, Finance Strategies, California Government Code, LWA and EPS.

[1] Can be implemented by cities, counties, special independent districts, and JPA's with these types of members.

[2] Advance Funding is defined as General Fund, developer, and/or other local public or private funding which could be subject to reimbursement from long term funding sources.

11.2.3.2 Local Funding within the Region

Local funding for projects and flood protection services has been generated a myriad of ways throughout the Region including general fund appropriations, pre- and post- Proposition 218 property assessments, special property taxes, development impact fees and enterprise funds. The following table outlines the known funding mechanisms implemented to generate local sources of funding for flood control improvements and services. Some of these funding mechanisms are legacy funding sources pre-dating Proposition 218; others are more recent efforts to generate local funding for specific projects and services.

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Table 11-13b. Local Funding Programs Currently in Place by Local Agencies in the Flood Region

Area	Funding Mechanism	Agency	Project / Uses	Approximate Annual Amount Generated	Note
Sutter Basin					
	SBFCA Assessment District	Sutter Butte Flood Control Agency	Feather River West Levee Project Improvements	\$6,650,000	Expected to generate approximately \$70 - \$80 million of Local Share of Funding
	Development Impact Fee Program (Levee Fee)	Yuba City & Sutter County within Yuba City SOI	Levee Improvements in the Sutter Basin	N/A	Applicable to Yuba City SOI. Collected in Unincorporated Sutter County within the City's SOI on behalf of the City. Jurisdictions currently evaluating the fee and applicability.
	Levee District 1	Levee District 1	Levee Maintenance and as needed Improvements	\$390,000	New Special Assessment formed to fund Levee Maintenance with some allocation toward Improvements.
	Levee District 1	Levee District 1	Levee Maintenance	\$7,500	Existing Assessment District Assumed to be Pre-Prop 218.
	Levee District 9	Levee District 9	Levee Maintenance	\$71,200	Combination of Property Taxes and Homeowner's Taxes
RD 10					
	Levee & Flood Control Facilities Assessment	Reclamation District 10	Implemented to Fund Levee Maintenance Budget, Improvements Authorized as use.	\$100,220 (FY 13/14)	Primary source of funding for Levee Maintenance.
Marysville Ring Levee System					
	Levee & Flood Control Facilities Assessment	Marysville Levee Commission	Marysville Ring Levee	\$238,000	Assessment to fund Improvements (expected to be paid over 10 years and additional costs of Maintenance) but eligible to fund maintenance thereafter.
	MLC Assessments	Marysville Levee Commission	Levee Maintenance	\$125,000	Existing in place assessment for maintenance

Area	Funding Mechanism	Agency	Project / Uses	Approximate Annual Amount Generated	Note
RD 784 / TRLIA					
	Three Rivers Levee Fee	Yuba County / TRLIA	Three Rivers Levee Improvement Program (Phases 1 - 4)	N/A	Currently undergoing 5-Year Update. Funding not expected to generate additional revenues for levee improvements. To be used to fund reimbursement of advanced funding provided for TRLIA Levee Improvement Program. However, this represents a cost to new development that reduces future capacity to fund additional improvements.
	TRLIA Mello-Roos CFD's	TRLIA	Various CFD's used to finance advance funded fees.	N/A	Special Taxes in certain Plumas Lake Developments used to upfront finance levee improvements. Represents a significant impact to funding additional services and improvements.
	TRLIA Assessment District	TRLIA	Enhanced maintenance services, can fund capital improvements from available revenues in excess of O&M need.	\$800,000	Annual amount will increase as development occurs.
	CSA 66	Yuba County	Levee Maintenance	\$50,000	Funding from County Service Area for internal drainage and levee maintenance.
	RD 784 Assessments	Reclamation District 784	Levee Maintenance	\$600,000	Funding from existing RD 784 assessment. Used for internal drainage and levee maintenance.
Wheatland					
	Bear River North Levee Assessment	Reclamation District 2103	Enhanced maintenance services for Bear River North Levee Improvements	\$81,790	Budget developed based upon analysis of allocation of desired O&M Budget apportioned to Bear River Levees.

Area	Funding Mechanism	Agency	Project / Uses	Approximate Annual Amount Generated	Note
	Bear River North Levee Project Impact Fee	City of Wheatland	Reimbursement of Bear River North Levee advance funding by the City of Wheatland	N/A	Funding not expected to generate additional revenues for levee improvements. To be used to fund reimbursement of advanced funding provided for BRNL EIP Project. However, this represents a cost to new development that reduces future capacity to fund additional improvements.
	Existing RD 2103 AD	Reclamation District 2103	Combined Special Assessment and Property Tax Apportionments	\$37,000	Existing pre-Prop 218 assessments and taxes.
RD 1001					
	Existing 1974 Assessment District	Reclamation District 1001	Funds both internal drainage and levee maintenance.	\$622,000	Existing pre-Prop 218 assessment.
	RD 1001 Assessment District	Reclamation District 1001	Local share of Critical Levee Repairs and Enhanced Levee Maintenance	\$300,000	Assessment District recently completed balloting (AD formed April 30, 2014).
<i>Sources: SBFCA, TRLIA, RD 1001, SCI Consulting Group, Economic & Planning Systems, RD 2103, Municipal Resource Group</i>					

11.2.4 Area Specific Funding Discussion

Each Area within the region has combined its own unique combination of federal, state and local sources. The following discussion details the current and expected sources by Area, as described in Chapter 8 for the Region.

11.2.4.1 Sutter Basin: Ongoing, planned and future funding

As in all areas of the Central Valley, funding of projects relies on highly interrelated State, local, federal funding sources to achieve Agency objectives. State funding is in a period of flux at this time due to evolving guidelines and policies regarding the use of remaining Bond 1e funding and implementation of the 2012 CVFPP.

11.2.4.2 Sutter Basin Federal Efforts

The Sutter Basin Feasibility study is the first major feasibility study for flood risk reduction completed under the Corps Planning Modernization Program. The study was completed by the Corps in October 2013 and transmitted to Congress in May 2014. The Study cost approximately \$11.7 million to complete and was funded jointly by the Corps, DWR and SBFCA.¹⁵

The Corps initiated the study in 2000 at the request of Sutter County and the CVFCB. SBFCA was formed in 2007 and ultimately became the local sponsor for the study. The Study concluded that the Recommended Plan for the levees in the Sutter Basin was the locally preferred plan, a fix-in-place rehabilitation of the Feather River West Levee from Thermalito Afterbay to 2250 feet south of Laurel Avenue. This plan is currently being implemented in advance utilizing funding sources from the State (Prop 1e and potentially Prop 84 bonds) and SBFCA (Assessment District). The approval of this Study by USACE Headquarters opens the door for potential crediting of SBFCA and State investments toward the remaining improvements needed in the basin. The next steps for the project include congressional authorization and appropriation, ultimately leading to design and construction of reaches not completed with State/local funding. The Sutter Basin Project is also anticipated to include authorization for non-structural risk reduction measures in the residual floodplain.

11.2.4.3 Sutter Basin Funding Strategy

Feather River West Levee Project & Oroville Wildlife Area Flood Stage Reduction Project & Gridley Bridge Bank Protection Project (L1, L3, L4)

As described in Section 8.1.1, SBFCA is currently pursuing its Feather River West Levee Project (FRWLP). This project consists of repairs to the west levee of the Feather River from Thermalito Afterbay to the confluence of the Feather River west levee to the east levee of the Sutter Bypass. The first phase of the FRWLP (L1, L3, L4) is a State and locally funded project implemented with the hope of attaining Federal credit toward the implementation of future projects within the basin and potentially outside the basin (contingent upon proposed legislation). In 2010, SBFCA formed an assessment district to fund the local match for the FRWLP. The Oroville Wildlife Area Flood Stage Reduction Project (OWAFSR) and Gridley Bridge Bank Protection project are separate, but complementary components that will be added to the FRWLP. The first phase of the FRWLP (L1, L3 and L4) consists principally of the rehabilitation of the west levee of the

¹⁵ June 10, 2013 letter to Mike Inamine, Executive Director SBFCA from Linda Finley, Deputy DPM Chief, Programs and Project Support Branch PPMD, USAED Sacramento District.

Feather River from Thermalito Afterbay in the north to Star Bend in the south; this levee protects the urban areas of the Sutter Basin. This work, combined with the OWAFSR Project and the Gridley Bridge Bank Protection project is estimated to cost approximately \$290 million. SBFCA has secured approximately \$138.9 million in State funding for portions of the first phase of the FRWLP and expects to secure additional State funding through post CVFPP implementation programs for the remaining portions.

Funding for the design and permitting of the OWAFSR project (approximately \$1.7 million) will be provided from DWR through the Yuba Feather Flood Protection Program, and SBFCA is pursuing a Wildlife Conservation Board grant (Prop 84) to fund ecological restoration of the OWA floodplain. SBFCA will also receive a \$460,000 YFFRP grant for the design and permitting Gridley Bridge Bank Protection project. SBFCA expects to receive State funding through an Urban Flood Risk Reduction Program for up to 81% of the remaining total project costs for the first phase of the FRWLP.

Table 11-14a. Active/Recent/In Process State Funding Sutter Basin

State Funding Program	Agency	Project ID	Description	Funding Committed/ Provided to Date	Status
YFFPP (Prop 13) - DWR	Sutter County / SBFCA	N/A	Sutter Basin Feasibility Study	\$1.4 Million	In Process
Early Implementation Program (Prop 1E)	LD1	N/A	Star Bend Setback Levee	\$16.6 Million	Completed
Early Implementation Program (Prop 1E)	SBFCA	L1	FRWLP Design	\$9 Million	In Process
Early Implementation Program (Prop 1E)	SBFCA	L1	FRWLP1 - Project Area C	\$56.78 Million	In Process
Early Implementation Program (Prop 1E)	SBFCA	L1	FRWLP1 - Areas B & D	\$78.8 Million	In Process
Flood Emergency Response Program (Prop 84)	LD1	N/A	Emergency Response Plans & Generators	\$.42 Million	In Process
Flood System Repair Project (Prop 1E & 84)	SBFCA	L2A / L4	FRWLP2 - Starbend and Laurel Avenue	TBD	In Process
YFFPP (Prop 13) - DWR	SBFCA	L5	Gridley Bridge Bank Erosion Repair Design	\$.46 Million	In Process
YFFPP (Prop 13) - DWR	SBFCA	L3	Design & Permitting OWAFSR	\$1.7 Million	In Process
Urban Flood Risk Reduction Program (Prop 1E)	SBFCA	L1	FRWLP1 (Remainder)	TBD	Anticipated
Urban Flood Risk Reduction Program (Prop 1E)	SBFCA	L2B	Implementation OWA FSR	TBD	Anticipated
TBD / System Improvement / FSRP	SBFCA	L2B	Remainder of Basin Area Plan	TBD	Planning

Source: Bond Accountability Website at CA.gov accessed January 16, 2014, Larsen Wurzel & Associates, SBFCA

As described above, the federal government has identified a federal interest in repairing the west levee of the Feather River from Thermalito in the north to 2250 feet south of Laurel Avenue. This reach extends approximately 6.5 miles south of the first phase of FRWLP (L1, L3, L4). The National Economic Development plan (NED) extends from Sunset Weir (near Live Oak) to south of Laurel Avenue, thus the portion of the project from Live Oak north of the Recommended Plan would be completely funded by the State and SBFCA. To this end SBFCA and the State wrote a letter to the Corps committing to fund the entire northern component of the Recommended Plan.

To finance the local share of the FRWLP, SBFCA initially secured a combination of \$6.5 million in unsecured loans from its member agencies, in advance of the formation of its assessment district. This funding helped finance the formation of SBFCA's Assessment District as well as advance the preliminary design of the project and secure a design grant from DWR. Shortly after the successful formation of its assessment district in July 2010, SBFCA secured a short term non-revolving line of credit with Rabobank for \$25 million to further advance the design of the project and commence property acquisition for its initial phases. In June 2013, in preparation for the start of construction, SBFCA issued \$41,035,000 of Assessment Revenue Bonds yielding \$40,000,000 in proceeds. SBFCA expects to issue additional long-term debt in 2015 to repay its \$25 million line of credit and yield additional proceeds to finish the remainder of its levee improvement program. The combination of SBFCA's Line of Credit, Revenue Bonds, annual assessment revenues, and proceeds from a final financing is expected to provide SBFCA with sufficient capital, potentially \$100 million, to meet the local share of the FRWLP and advance a portion of later phases of work (L2A and L2B).

Funding for Remaining Sutter Basin Work (L2A and L2B)

The remainder of the basin is protected by the lower, approximately 9 miles of the Feather River, Sutter Bypass and Wadsworth Canal (L2B). These levees are currently being evaluated by SBFCA to identify critical reaches that, if repaired, could significantly reduce risk for the basin, and incrementally meet 100-year level of flood protection. The SBFCA goal of 100-year level of protection for the entire rural, southern basin can occur only with substantial State or federal investment in the Sutter Bypass and Wadsworth levees, as the Assessment District does not possess the requisite financial capacity. DWR is obligated to restore function of the Sutter Bypass and Wadsworth Canal to safely pass the design stage under Water Code 8361, and because the 55/57 profile is higher than the 100-year WSE, the SBFCA goal would be met. Recently however, the State indicated that this obligation may not be fulfilled for decades, if ever, given other State-wide priorities and limited resources. As described in Chapter 8, the Agency is pursuing a program of critical repairs coupled with FEMA regulatory relief for agricultural areas.

SBFCA is currently progressing with remaining Sutter Basin projects. A portion of this work will be funded through DWR's Flood System Repair Project (FSRP) program. Two critically damaged reaches of levee south of Star Bend have been identified by both SBFCA and DWR, and preliminary design work is currently in progress. As noted earlier the federal project extends south of Star Bend (currently the southern limit of State funding for L1) by approximately 6.5 miles. Thus, the first phase of the FRWLP combined with the proposed FSRP grants and eventual federal appropriation will provide complete funding to this southernmost point: L1, L2A, L3, L4. In addition, as the State completes its basin wide feasibility studies and identifies system wide improvements, portions of the Sutter Basin may be addressed by State funding. The amounts and types of funding will depend upon the identified improvements and programs to mitigate risk within the remainder of the region after the FRWLP. The outcome of the DWR basin-wide study may result in, or support, the pursuit of a Post-Authorization Change Report to address newly identified risk reduction measures that are in the federal interest and comport with the 2017 CVFPP.

Table 10-14a below identifies the completed, in process, anticipated State funding for projects in the Sutter Basin.

Funding for Operations and Maintenance

Ongoing operations and maintenance within the Sutter Basin is currently funded by several different entities including the State through various State Maintenance Areas. As noted in Table 11-11, the Local Entities, LD1 and LD9 within the Sutter Basin have existing revenues funding levee operations and maintenance. The adequacy of this funding stream along with the ability of State Maintenance Areas to fund work has been

addressed by SBFCA as part of its current funding programs for work currently underway. Reviews of current operations and maintenance activities, as they relate to current construction work, has taken place. SBFCA will need to continue to address OMRR&R funding for the remainder of its project as it moves forward with this work.

11.2.5 RD 10

At this time RD 10 has not identified or secured local, State or Federal funding for current or planned improvements within the area. However, specific to Yuba County is the ability of the Yuba County Water Agency to provide discretionary funding toward the local contribution of flood control improvements. This potential program is described further below in Section 11.2.10. These funds could be used to provide the local match for potential State funding.

The improvements identified within Section 8.1.2 would need specific analysis and future plans developed to identify potential sources of funding and financing to be implemented. As noted in Section 8.1.2, RD 10's 2008 assessment district formation process was specifically intended to provide funding for ongoing maintenance and operations, however, the specified services within the Engineer's Report do include improvements of the levee system. To the extent that the District's budgets could provide funding for improvements, the District, in theory could use this revenue to improve its levee system, however, it is unlikely that the District could rely on this strategy to provide any meaningful funding for the identified improvements.

The majority of Projects identified within Section 8.1.2 for RD 10 include critical repairs and resolving access issues related to the ability to perform proper maintenance. DWR's FSRP program has identified projects that could be eligible for funding. However, RD 10 will need to identify local matching funds for these projects. As projects are identified through this program RD 10 will need to secure matching funds, however, funds may be limited due to the funding capacity of the area. See discussion in Section 11.2.12. **Table 11-14b** below identifies the anticipated State funding for projects in the RD 10 area.

Table 11-14b. Active/Recent/In Process State Funding RD 10

State Funding Program	Agency	Project ID	Description	Funding Committed/ Provided to Date	Status
FSRP	RD 10	L1, 2, 4, 5	Critical Repairs eligible under FSRP	\$263,500	NOE for portion of Work
<i>Source: Larsen Wurzel & Associates, MBK</i>					

11.2.6 Marysville

Yuba Basin General Reevaluation Report

In 1991, at the request of the Yuba County Water Agency (YCWA), the Corps initiated a feasibility study of water resource problems and opportunities in the Yuba River Basin. A recommended plan was completed as part of the 1998 Yuba Basin Investigation and was authorized for construction by the 1999 Water Resources Development Act (WRDA). Construction was authorized for the Marysville Ring Levee, all of the Yuba and Feather River Levees in Linda/Olivehurst and a portion of the Feather River levee in lower RD 784. The remainder of the RD 784 system on the lower Feather, lower Bear and WPIC was found to be adequate.

As a result of 1986 and 1997 floods in RD 784, and the ultimate reevaluation of methodologies for evaluating the effect of through and under seepage in evaluating levee performance, the State of California requested that the project be reevaluated to determine if there was additional Federal Interest in the project. This resulted in the initiation of the General Reevaluation Study.

The Corps has been working to complete a General Reevaluation Report (GRR) for the Yuba River Basin Project. This effort would ultimately lead to an evaluation of the improvements within the RD 784 Basin and Marysville that could lead to the release of additional credit for the completion of the Marysville Ring Levee project (described further below). The vast majority of the previously authorized components of the Yuba Basin Project have been completed by TRLIA. This plan for crediting includes a combined Post Authorization Documentation Report (PADR) and Integral Determination Report (IDR). The PADR describes the design and cost changes since the original authorization of the Yuba Basin Project and the IDR provides details showing that work completed in the RD 784 Basin on the Yuba River and Upper Feather River are both economically justified and integral to the original 1999 authorized project. This allows enough Federal credit to cover the total estimated remaining non-Federal share (\$23 million) of the project. The PADR was approved in December 2012 and the IDR was approved in April 2014. Approval of this credit to fund the non-Federal share of Marysville does will not require Congressional authorization and approval is expected in late 2014. However it will require regular appropriations from Congress. As noted previously, current annual federal appropriations have been limited to \$2-\$4 million per year which is forcing the local sponsors to evaluate additional alternatives to advance the completion of the project with local funding.

Marysville Ring Levee System

The USACE has one ongoing levee improvement project within the Flood Region, the Marysville Ring Levee project. As previously discussed within Chapter 8, the project cost is estimated to be \$90.5 Million. The Federal share of this project, 65%, is to be funded by the USACE. The Local Share of project, 35% is the responsibility of the State and the Marysville Levee Commission (MLC). The vast majority of the local

share¹⁶ is expected to be funded by the Federal government through credit for projects completed by TRLIA within the previously authorized Yuba River Basin project. The remaining local share of the project (5% plus the LERRDS) is being funded by the State and the MLC on a 70/30 basis. The State is funding its share through Proposition 1E and the MLC is funding its share through a benefit assessment district passed by property owners within Marysville in July 2009.

Current active, recent and anticipated State funding for Marysville work is summarized in the **Table 11-14c** below.

Table 11-14c. Active/Recent/In Process State Funding Yuba GRR & Marysville Ring Levee System

State Funding Program	Agency	Project ID	Project	Funding Committed/ Provided to Date	Status
Feasibility Studies Program Proposition 1E	YCWA	N/A	Yuba Basin General Revaluation Report	\$2.8 Million	In Process
Proposition 1E USACE Projects	YCWA/MLD	L2 - L3	Marysville Ring Levee Project	\$11.77 Million	In Process

Source: Bond Accountability Website at CA.gov accessed January 16, 2014, Larsen Wurzel & Associates, MBK

11.2.7 RD 784

11.2.7.1 Three Rivers Levee Improvement Authority

For nearly the last decade, TRLIA has been working to plan, finance and implement over \$400 million of improvements in South Yuba County. As noted in Section 8.1.4, funding for this work has come from a myriad of sources including DWR, YCWA, Yuba County and local property owner interests.

TRLIA has been the recipient of several different State grants to cost share in portions of the TRLIA Program. Those grants have included funding from the Yuba Feather Flood Protection Program, the Early Implementation Program and others. A summary of those State Grants is provided in **Table 11-14d** below.

Table 11-14d. Active/Recent/In Process State Funding RD 784/TRLIA

State Funding Program	Agency	Project ID	Project	Funding Committed/ Provided to Date	Status
YFFPP (Prop 13) - DWR	TRLIA	N/A	Phase 2 - Upper Bear River, WPIC & Lower Yuba, PS 6	\$5.3 Million	Funded Amount
YFFPP (Prop 13) - DWR	TRLIA	N/A	Phase 3 - Bear River Setback Levee Design	\$3.26 Million	Funded Amount
YFFPP (Prop 13) - DWR	TRLIA	L4*	Phase 2 - Repairs	\$15.65 Million	Funded Amount
YFFPP (Prop 13) - DWR	TRLIA	N/A	Phase 3 - Bear River Setback Levee Construction (1 & 2A)	\$12.45 Million	Funded Amount

¹⁶ The federal government will fund up to 95% of the total project costs excluding LERRDS (Lands, Easements, Rights-of-way, Relocation and Disposal Areas), made up of 65% federal share and 30% credit for other authorized projects completed from local sources.

State Funding Program	Agency	Project ID	Project	Funding Committed/ Provided to Date	Status
YFFPP (Prop 13) - DWR	TRLIA	N/A	Phase 3 - Bear River Setback Levee Construction (2B)	\$6.1 Million	Funded Amount
Department of Fish & Game (Prop 13)	TRLIA	N/A	Phase 3 - Bear River Setback Area (Restoration & Mitigation)	\$18.6 Million	Funded Amount
Early Implementation Program (Prop 1E)	TRLIA	L2	Phase 4 - Feather River Setback / Strengthen In Place	\$154.79 Million	In Process
Early Implementation Program (Prop 1E)	TRLIA	L1, L5	Phase 4 - Upper Yuba River / WPIC / Area Plan Remainder	\$47.43 Million	In Process
YFFPP (Prop 13) - DWR	TRLIA	L3	Goldfields Feasibility Study	\$2 Million	In Process
FESSRO Conservation Strategy & Framework	TRLIA	TBD	Feather River Floodway Corridor Restoration	\$4.4 Million	In Process
<i>*FEMA Funding was received for Olivehurst Detention Basin Work as Part of TRLIA's Phase 2 efforts.</i>					
<i>Source: Bond Accountability Website at CA.gov accessed January 16, 2014, Larsen Wurzel & Associates, TRLIA</i>					

TRLIA's source of local funds to match the above listed grants is fairly straight forward; however the process of capitalizing those revenue sources is complex and involves several different entities.

Shortly after TRLIA was established in 2004, TRLIA worked with locally property owners in the Plumas Lake and North Arboga area to provide advance funding of the levee improvements with the understanding that this funding would ultimately be applicable (i.e. creditable) toward any final fees or exactions due at the time development interests moved forward with a residential development project. The premise at the time was that TRLIA and the County would ultimately implement a Development Impact Fee program or adopt a Financing Plan to ensure that all development interests in the Plumas Lake Specific Plan and North Arboga Study Area paid a fair share contribution toward flood control improvements. In order to ensure that development did not progress in advance of the project, as a condition of the issuance of one of TRLIA's early encroachment permits from the Reclamation Board, the number of building permits available to be issued in 2005 and 2006 was voluntarily limited by the County. As engineering studies advanced and additional improvements were identified, development interests entered into a supplemental funding agreement to provide additional advance funding under the same crediting premise. In 2005, the County, TRLIA and local landowners entered into an additional funding agreement that tied the limited number of building permits to advance funding of levee improvement. Finally, as the need for even more improvements were identified and funding deficiencies were further clarified, in 2006 another funding agreement was entered into by land owners in the region to provide additional funding for levee improvements.

In 2006, as a condition of the funding agreements entered into by Yuba County and TRLIA with development interests, the County adopted the Three Rivers Levee Fee. This Development Impact Fee became the singular and ultimate basis under which all new development in Yuba County would fund levee improvements. The County would impose the fee on all new development lying within the area benefited by TRLIA's program and those developments that provided advance funding under prior agreements would receive credit toward their ultimate fee obligations or, in some cases, reimbursement for excess funding.

In 2008, after nearly \$78 million of local funding had been provided by local development interests in South Yuba County, in the midst of the housing downturn, the remaining local funding for the project dried up. A

remaining funding need of approximately \$46 million was identified. In order to generate the remaining local share of the program, the County and Yuba County Water Agency issued general obligation bonds (COP's) in the amount of \$78.37 million to yield \$46 million in funding to complete the project. The proceeds of these bonds have continued to fund the remaining local share of the TRLIA program to date.

The remaining work identified in Section 8.1.4, includes work to remediate right of way and encroachment issues within the RD 784 system, improve the WPIC levee to resolve ULDC deficiencies, and implement improvements within the Yuba Goldfields to ensure that water cannot exit the Goldfields flanking the south levee of the Yuba River during a flood event.

L1 & L5 – WPIC Levee Improvements & Yuba 1986 Break Site (ULDC Remediation)

Funding for improvements along the WPIC is planned to be incorporated into TRLIA's current EIP Grant. The local share of these costs has already been secured through the TRLIA Development Impact Fee and associated financing program.

L2 – Right of Way / Encroachment Issues

Funding for specific portions of the Right of Way and Encroachment issues in the RD 784 system can come from a myriad of sources. TRLIA is currently resolving some of those issues that fall within the segments of levees covered by the EIP grants received by TRLIA. The balance of needed funding could come from the Three Rivers Levee Impact fee and financing proceeds from YCWA and Yuba County, and/or funding could come from RD 784.

In 2009, TRLIA formed an Assessment District to Levee & Flood Control Facilities. The primary purpose of this Assessment District was to fund the enhanced maintenance activities of RD 784 associated with TRLIA's Levee Improvement Program thereby ensuring that the system could meet FEMA 100-Yr certification criteria. The Engineer's Report of the Assessment District noted that, to the extent future development within the Plumas Lake Specific Plan and North Arboga Study Area occurred within the RD 784 basin, that additional incremental assessment could be generated. These additional assessments could be used to fund additional improvements, or repay TRLIA for previously incurred costs thus allowing TRLIA to utilize these funds, to cure remaining encroachment and right of way issues.

L3 – Yuba Goldfields

Funding for an alternatives analysis has already been secured by TRLIA through DWR's Yuba Feather Flood Protection Program. In addition, TRLIA has completed a portion of the immediately needed 100-Year improvements. The current feasibility study work will identify the extent and costs of the remaining 100-Year and 200-Year actions and address the funding of these issues. Local funding for this work could come from the TRLIA Development Impact Fee and associated financing program, however, additional local and State funding sources will likely need to be identified. Local funding could come from the Yuba County Water Agency through a discretionary funding program for flood control improvements. This potential program is described further below in Section 11.2.10.

L4 – Olivehurst Detention Basin incorporation into SPFC

As discussed in Chapter 8, the Olivehurst Detention Basin was constructed in 2006. The remaining scope of work related to the project is to incorporate the facility into the State Plan of Flood Control and Sacramento River Flood Control Project list of facilities. TRLIA plans to use local funds to process this effort.

11.2.8 Wheatland

Funding for projects protecting the Wheatland area has consisted primarily of work associated with the Bear River North Levee Rehabilitation Project. In 2006, RD 2103 prepared a Problem Identification Report for the Bear River levee that identified levee under seepage and instability deficiencies. The Bear River North Levee Rehabilitation Project (“Project”) was designed to remediate these deficiencies. Design of the Project began in 2006 and construction was substantially complete in 2010. The total cost of the Project was approximately \$20.1 million with funding coming from State and Local sources. RD 2103 received an EIP grant from DWR of approximately \$10.8 million. The remaining local funding for the project was advanced by the City of Wheatland. The City and local developers entered into a series of agreements advancing funds for the local share of the Project cost and committing to certain related reimbursement obligations. The ultimate source of local funding for the City is a Development Impact Fee. As future development occurs within the City, development impact fees will be collected to reimburse those parties that advanced local funds for the Project.¹⁷

To ensure that the improvements that were completed could be certified so that portions of the City would be removed from the FEMA 100-year flood plain, RD 2103 formed an Assessment District to generate funding for the enhanced levee maintenance of the Bear River North Levee. However, the Engineer’s Report for the Assessment District identified residual flooding and that remaining improvements within RD 2103 and 817 still need to be completed. The Engineer’s Report notes that future funding needs and sources to resolve the residual flooding were to be identified.¹⁸ As a result of the residual flooding, those properties impacted received reduced assessments.

Further described in Section 8.1.5 are additional improvements to the Bear River North Levee located in RD 817 as well as other improvements to Dry Creek. Potential State funding for the identified projects could include DWR’s FSRP program as well other programs that include feasibility study funding. A feasibility study for Dry Creek has been preliminarily identified in the Yuba Feather Flood Protection Program (YFFP) and RD 2103 will continue to pursue that 100% State cost share. In order to secure State funding, it will be important for local interests in the Wheatland Area to work to generate local matching funds. As noted previously, local funding could come from the Yuba County Water Agency through a discretionary program for flood control improvements. This potential program is described further below in Section 11.2.10. A summary of those State Grants is provided in **Table 11-14e** below.

¹⁷ City of Wheatland Bear River North Levee Rehabilitation Project Impact Fee Mitigation Fee Act – Nexus Report, Prepared by Municipal Resource Group, LLC, April 2013.

¹⁸ Final Engineer’s Report, Bear River Levee Operation and Maintenance Assessment District prepared for Reclamation District 2103, Economic & Planning Systems, Inc., July 22, 2010

Table 11-14e. Active/Recent/In Process State Funding Wheatland

State Funding Program	Agency	Project ID	Project	Funding Committed/ Provided to Date	Status
Early Implementation Program (Prop 1E)	RD 2103	N/A	Bear River North Levee Rehabilitation	\$10.8 Million	Completed
Flood System Repair Project (Prop 1E & 84)	RD 817	L1	Bear River North Levee	TBD	In Process
YFFPP (Prop 13) - DWR	RD 2103 /RD 817	L2, L3, L5, L6, L7	Dry Creek Evaluations and Studies	\$797,000	In Process

Source: Bond Accountability Website at CA.gov accessed January 16, 2014, Larsen Wurzel & Associates, MBK

L1- The Flood System Repair Project has identified projects along the remainder of Bear River North Levee in RD 2103 and RD 817. This program could provide State funding if a Local funding match is identified. In order to generate a local share, interests in the region should evaluate the feasibility of implementing a new assessment district or a supplemental development fee to generate the local share needed. Financing could be provided by the Yuba County Water Agency. Further evaluation of this approach should be analyzed as part of the project planning process.

L2, L3, L5, L6 – Work related to Dry Creek is moving forward with the commitment of DWR funding through the YFFPP. Funds to implement identified improvements have not been secured. As a component of the feasibility analysis, an evaluation of funding and financing should be completed.

L7 – Bear River North Levee ULDC Compliance – This work consists of evaluation and will likely need to be funded by local sources. RD 2103, Yuba County and the City of Wheatland will need to coordinate this effort as it relates to land use issues associated with ULDC compliance.

L8, L9 - The remaining work identified by 817 and RD 2103 will be long term. Any Federal, State and Local funding sources will need to be identified in the context of interest and funding capacity.

11.2.9 RD 1001

11.2.9.1 Mid Valley Area Phase III Federal Project

The storms of February 1986 severely affected northern California with record or near record flows in many rivers and streams, after which USACE conducted a system-wide analysis of the Sacramento River Flood Control Project (SRFCP) to upgrade to current design standards. This is referred to as the “Sacramento River Flood Control System Evaluation”. Mid-Valley Area Phase III is a component of the authorized SRFCP and is divided into four separable elements: Contract Area 1 - RD 1500 (construction completed in 1999); Contract Area 2 - RD 1001 (a future project); Contract Area 3- Knights Landing (an ongoing project within the Lower Sacramento Region); and Contract Area 4 - Elkhorn (future project within the Lower Sacramento Region). In 1996, USACE approved the Mid-Valley Area, Phase III Design Memorandum (DM), which recommended 30 levee reconstruction sites within the four contract areas. A portion of those projects lie within the RD 1001 area. At some point in the future, the USACE may initiate design of those works and share in the cost.

11.2.9.2 RD 1001 State and Local Efforts

As previously discussed in Section 8.1.6, DWR’s FSRP program has identified areas in the levee system maintained by RD 1001 as in “critical” need of repair and DWR has provided eligibility letters for State funding to the district. The estimated cost of the critical repairs has been identified and RD 1001 is expected to contribute up to 20% (approximately \$1.0 million) from local sources. To generate these local sources, the Agency commissioned the development of an Engineer’s Report and commenced the Proposition 218 legislative process to raise new Assessment to generate funding. This District was formed in April 2014 after a property owner balloting process with 82 percent of the weighted vote in favor of the assessment. The new assessment will generate approximately \$309,000 per year for maintenance and repairs.¹⁹ In addition, RD 1001 has identified a source of in-kind materials that it can provide to meet a portion of its local funding requirement for the identified projects. **Table 11-14f** shows the projects and funding sources identified from the State.

Table 11-14f. Active/Recent/In Process State Funding RD 1001

State Funding Program	Agency	Project ID	Project	Funding Committed/ Provided to Date	Status
Flood System Repair Project	RD 1001	L1	Critical Repairs	TBD	In-Process and Anticipated
Flood System Repair Project	RD 1001	L2	Re-rock levee crown patrol roads.	TBD	Planning

Source: Larsen Wurzel & Associates, MBK, SCI

L1, L2 – Funding through the State’s FSRP Program has been identified for these projects. RD 1001 is currently in the process of securing the Local matching funds needed.

L3 – The replacement of pipe and grouting is a maintenance issue and is expected to be completed by RD 1001 through in-kind work provided by local property owners.

L4 – Erosion protection work along the Bear River levee is being pursued through FSRP Proactive repairs and Sacramento River Bank Protection Programs.

L5 – L7 – RD 1001 should work to identify State funding opportunities through future DWR funding programs. Internal drainage related work could be funded through IRWM Grant programs with further evaluation. Local funding for this work should be evaluated and identified as project plans are developed.

Additional projects identified within this plan will need additional State and local funding sources identified as projects plans are further developed.

¹⁹ Approximately \$250,000 for maintenance and \$59,000 for repairs annually. Source: Reclamation District No. 1001, Levee and Flood Control Facilities Maintenance and Repair Assessment Engineer’s Report – DRAFT, SCI Consulting Group, February 2014.

11.2.10 Other Funding Sources and Strategies

11.2.10.1 Yuba County Water Agency

As previously noted, future local funding (to match State funds) for additional work identified within the sub-basins in Yuba County could come from the Yuba County Water Agency (YCWA). Part of YCWA's mission is to advance flood protection efforts within Yuba County through the proper stewardship of assets owned and operated by the Agency. To advance this mission, the Agency has adopted a Flood Management Strategic Plan that outlines objectives and strategies for achieving those objectives as it relates to reducing flood risk in the County. Some of the specific strategies identified in the Strategic plan include providing planning or financial assistance to Yuba County, levee districts and governmental entities to assist with;

- Efforts to define the flood protection system for the urban areas, system deficiencies, and alternatives to correct those deficiencies.
- Efforts to develop an emergency response plan for residents in the floodplain and coordinate emergency response activities among jurisdiction in the region.
- Efforts to achieve the goal of improving the flood protection systems to meet the State's 200-year level of protection requirements through participation in.
 - The USACE's Civil Works Program activities in the County including the Yuba Basin GRR (or alternate path to obtaining Federal credit to fund the non-Federal share of the Marysville Ring Levee Project) and construction of the Marysville Ring Levee Project.
 - DWR's plans to implement the portion of the Central Valley Flood Protection Plan (CVFPP) that affects Yuba County including RD 2103's efforts on the Bear River, TRLIA's effort to improve the RD 784 levee system to and make a findings that the urban portions meet the State's 200-year requirements.
 - Efforts to consolidate maintenance, management and engineering activities where consolidation helps improve efficiencies.
- Development of an emergency response plan for residents in the floodplain.
- Emergency levee repairs.

Funding from YCWA will come from future revenues generated from future revenues generated from a new Power Purchase Agreement effective May 1, 2016..

11.2.10.2 Other Non-Local Funding Sources

Opportunities exist for local agencies to leverage funding from Non-Governmental Organizations (NGO's) for projects that have components or features that align with the interest of those agencies. Opportunities for funding could include funding for environmental restoration and agricultural easement acquisition through Natural and/or Local Resource conservation Districts, Land Conservation Banks, and specific conservation groups. Environmental enhancement and open space projects that are funded by the NGO's could lead to opportunities to leverage additional State funding for flood risk reduction projects to the extent the combined multi-benefit projects align with certain objective criteria for State Funding resulting in supplemental cost sharing. As local project proponents evaluate available funding options for projects, agencies should look for opportunities to combine or add features to projects that combine funding sources and that ultimately result in the lowest net local cost.

11.2.11 Relative Local Funding Capacity for Additional Improvements & Services

Given the existing constraints of local jurisdictions to generate additional local funding for improvements and services (O&M), namely Propositions 13, 218 and 26, the two most feasible and currently utilized ways for local jurisdictions to generate funding are from self-imposed taxes and assessments and development impact fees. As further described above, Development Impact fees provide a mechanism for a local land use jurisdiction to charge new development for its proportionate share of the cost of providing a service to that development. New development cannot be charged for the cost of curing a service deficiency to existing development. New development can only be charged for the proportionate impacts it has on existing and new services.

To provide insight to the Region, and the sub-areas within it, regarding the capacity for new taxes and assessments, a simplified methodology and approach to determining capacity was developed.

11.2.11.1 Assessment Capacity Approach

In order to determine whether relative capacity for additional flood control assessment exists within an area of the region, a comparison of the existing assessments for flood control within the each sub-area was made to typical assessments among all of the regions in the CVFPP. This comparison approach is simply used an indicator of whether existing assessments could increase thereby providing a means to assess whether any additional capacity for direct assessment charges for flood control exist within a sub-region.

A survey of 12 different recent purely flood control improvement and service assessments imposed throughout the California Central Valley was conducted to determine the typical assessment rates imposed in recent years. **Table 11-15** provides the range of typical assessment rate ranges for various land uses subject to these flood control assessments.

The sampled districts are of differing sizes (in terms of number of parcels impacted), have differing approaches and methodologies for the apportionment of benefit and have differing budgets associated with the improvements and services being provided. As a result, the rates and average assessments vary significantly. However, the one thing these districts have in common is that they have all been relatively recently imposed and subject to a Proposition 218 property owner balloting processes. The districts have had similar input from property owners on their imposition. Given this, the rates shown in **Table 11-15** could be interpreted as an indicator to the typical limits that property owners are willing to pay for similar services given single question put forth on a ballot presented to them.

Table 11-15. Typical Flood Control Benefit Assessment Rates by Property Type

Land Use Category	Unit	Annual Assessment Rate Range		Typical Annual Rate
		min	max	
Residential [1]	Per Unit	\$25.00	\$300.78	\$123.03
Industrial (Per 1,000 SF) [2]	Per 1,000 SF	\$3.76	\$333.56	\$79.48
Rural/Agriculture (Per Acre)	Per Acre	\$0.77	\$21.83	\$7.79
Commercial (Per 1,000 SF) [3]	Per 1,000 SF	\$14.13	\$320.30	\$96.47
Government (Per 1,000 SF) [3]	Per 1,000 SF	\$1.12	\$232.00	\$80.68
[1] Includes both typical Single Family units (assumed to be 1,500 SF on 1/4 Acre of Land flooded to 5').				
[2] An FAR of .25 is assumed for typical Industrial land, assumption assumes flooding to 5'.				
[3] An FAR of .4 is assumed for typical Commercial & Governmental land, assumption assumes flooding to 5'.				
<i>Source: SAFCA, SJAFCA, SBFCA, RD 10, RD 17, RD 2103, RD 1001, WSAFCA, TRLIA, KLRDD & MLC.</i>				

In order to adjust for the economic differences between each sub-region and the overall sample population of the typical assessments, an adjustment factor has been applied to determine proportional increase in relative additional funding capacity. The existing Single Family residential assessment rate is used as a proxy for determining the ability to increase the assessment.

Anecdotal evidence suggests that it is typically the single family residential assessments that control the outcome of Proposition 218 assessment ballot proceedings. This is due to the fact that balloting process is controlled by only those ballots that are received by the close of balloting period (the required public hearing). Because the returns are higher in this category of assessment, the residential property usually controls the outcome of the election.

Table 11-16 provides an estimate of the potential increase in capacity for each area within the region based upon this simplified approach.

Table 11-16. Residential Property Assessment Capacity by Zone

<u>Zone</u>	<u>Existing Residential Rate</u> [1]	<u>Typical Residential Rate</u>	<u>Potential Marginal Capacity</u>	<u>Economic Adjustment</u> [2]	<u>Potential % Increase</u>
Marysville Ring Levee System	\$74.67	\$123	\$48.36	81%	53%
RD 1001 [3]	\$241.25	\$123	N/A	N/A	N/A
RD 784 / TRLIA	\$218.56	\$123	N/A	N/A	N/A
Reclamation District 10	\$100.00	\$123	\$23.03	123%	28%
Sutter Basin [4]	\$121.44	\$123	\$1.60	101%	1%
Wheatland	\$229.92	\$123	N/A	N/A	N/A
[1] Reflects a typical benefit assessment on a typical single family unit plus the average of any pre-prop 218 assessment or charge for flood control already in place.					
[2] Median household income of area as a percentage of the weighted average median household income of the entire central valley flood protection plan regional flood management plan planning areas.					
[3] RD 1001 "Existing Residential" rate represents a new Assessment District recently formed as well as a Pre-Prop 218 direct billed assessment of \$25 per Single Family Unit.					
[4] The "Existing Residential" rate across the Sutter Basin varies widely given multiple jurisdictions that provide flood control services. The rate is representative of a sampling of parcels throughout the basin.					
<i>Source: Yuba & Sutter County Parcel Tax Bills, Claritas 2013, Larsen Wurzel & Associates</i>					

The above approach takes into consideration other taxes and assessments for flood control currently burdening the sub-areas. This approach for determining capacity concludes that only three of six sub-regions would have capacity to increase assessments presuming that the typical residential rate within the Central Valley is a representative “cap” or limit on the passage of a new assessment or tax for flood control.

In order to gauge the relative gross assessment capacity for an increase in assessments, the property assessment budgets for the representative agencies within each sub-region was evaluated as a representative a proxy for the total budget that could be increased.

Table 11-17 shows the increase in property assessments for the areas that would have additional capacity based on the single family residential increase proxy described above.

Table 11-17. Total Adjusted Assessment Capacity by Zone

<u>Zone</u>	<u>% Increase of Assessment</u>	<u>Total Existing Revenues</u>	<u>Estimated Additional Annual Assessment Capacity</u>
Marysville Ring Levee System	53%	\$294,592	\$155,175
Reclamation District 10	28%	\$93,934	\$26,622
Sutter Basin [1]	1%	\$7,175,281	\$95,473
[1] The Sutter Basin revenues are based upon the property assessment budgets for SBFCA, Levee District 1 and Maintenance Areas 7, 16 & 3.			
Source: State Controller's Special Districts Annual Report (FYE June 30, 2012)			

As a result of the relatively small budgets associated with the Marysville Levee District and Reclamation District 10, the resulting increases, on a percentage basis, are relative high; however, on a gross magnitude basis they are relatively small.

With respect to the Sutter Basin, given that the typical assessments through the basin are generally equivalent to the typical assessments throughout the Central Valley, the percentage increase is relatively small and only results in a nominal amount of additional Assessment Capacity. However, because of the relative size of the district, and the range of assessments within the Basin, a relatively small increase in assessments could result in relatively larger amount of additional capacity. Additional analysis with respect to potential rate increases and the spread of the rate increase within the constraints of Proposition 218's benefit requirements would need to be explored.

11.2.11.2 Tax Rate and Infrastructure Burden Considerations

In order to consider an area's ability to generate additional taxes and assessment, the uses of taxing capacity for all infrastructure and services should be considered. The California Debt and Investment Advisory Commission (CDIAC) promulgates guidelines with respect to land-secured financing, including the use of assessments and Mello-Roos. CDIAC's Mello-Roos Guidelines (1991) suggest that jurisdictions should integrate Mello-Roos financing into the land use regulatory framework. Local governments should do this so that there is a process for coordinating the use of land-secured financing. The concern is that in the absence of coordinated planning, taxpayers could be vulnerable to onerous overlapping tax burdens imposed by a multitude of local governments that may provide services to the same group of tax payers. This issue is analogous to the current ongoing efforts associated with planning for the future of flood control infrastructure. To the extent that there are a multitude of planning efforts all developing concurrent funding and financing strategies, these efforts should be coordinated to ensure that there is sufficient funding capacity available from the identified beneficiaries and that current LMA funding programs for maintenance not be impacted.

The tax burdens that would be required to fund the entirety of local share of needed flood control infrastructure within the Flood Region could be significant. The PPIC's report "Paying for Water in California," notes that Sutter, Butte and Yuba counties represent three of the top six highest annual per capita costs to fill the flood control funding gap. The per capita annual funding gap noted within the report for Sutter County would exceed \$1,350. This infrastructure burden could not be financed on the property tax rolls of Sutter County as this level of financing would well exceed the reasonable equitable tax burden for Sutter County.

A reasonable land secured financing would be supported by property tax burdens that would not exceed 2% of the market value of the improved property. Some jurisdictions, including Yuba County, limit this amount to only 1.8%. The 2013 median home price within the flood region is approximately \$207,000. At a 2.0% limit, after leaving a conservative 1.1% for current ad valorem overlapping debt, the median home would only be

able to support an additional \$1,600 of annual taxes to fund all other annual infrastructure and service costs within the reasonable financing limit. The vast majority of the region already has utilized a portion of this (approximately 0.1%) to fund flood control services. It would be unreasonable to assume that all of the remaining tax limit could be captured to finance and fund additional flood control infrastructure and services. Furthermore, the approval processes for additional taxes and assessments governed by Proposition 218 presents significant challenges to local jurisdictions. This further erodes at the ability to capture available funding capacity.

As the Flood Region and other entities develop more detailed plans for funding services and infrastructure, a coordinated approach must be made to ensure that the funding capacity for infrastructure is not pre-empted by other entities and that the financing goals and policies of the region's jurisdictions are reflective of their priorities. Coordination with State led efforts to fund system wide improvements will also need to take place to ensure that any proposals for funding State programs do not pre-empt locally led efforts and priorities.

11.2.11.3 FEMA Flood Insurance – A Pricing Mechanism

Flood risk reduction projects have a unique pricing mechanism in the Federal Emergency Management Agencies (FEMA) National Flood Insurance Program (NFIP). The potential for being mapped into a 100-year flood plain provides communities with a metric to make informed decisions to determine if it would be less expensive to pay for flood insurance or tax themselves to pursue construction of flood improvements.

The NFIP established the 100-year flood as the threshold for determining if structures with federally guaranteed mortgages are required to purchase flood insurance. Currently, the NFIP makes flood insurance available to structures located within participating communities at subsidized rates. However, federal legislation passed in 2012 (The Biggert-Waters Flood Insurance Reform Act of 2012 or "BW-12") was intended to make flood premiums more representative of the actual risk posed from flooding (the actuarial rate). While recent legislation signed into law in March 2014 (the Homeowner Flood Insurance Affordability Act of 2013 or "HFIAA") makes modifications to BW-12 with respect to current subsidized insurance rates, initial guidance provided by FEMA indicates that flood insurance premiums will still be increasing.

The federal government's decision to move toward actuarial rates provides a direct linkage between the cost of insurance and structural flood risk reduction improvements. Because the vast majority of homes within the US are financed with federally guaranteed mortgages that require flood insurance, in the face of 100-year flood risk, the cost of mitigation cannot be escaped by the homeowner. Simply put, a homeowner with a home located in a floodplain will face a cost, either a flood insurance premium cost, or a cost to demonstrate that their property should not have been mapped within the 100-year floodplain, or a cost to construct structural flood risk reduction improvements that provide a minimum 100-year level of protection. It is reasonable to assume that a practical homeowner would prefer the lesser of these costs. In the case of many communities within the Central Valley of California located within deep floodplains expensive structural levee improvement projects are required to meet the FEMA 100-year standard.

There are, however, limits to direct correlation of flood insurance rates and the ability of a local community to tax itself. The direct linkage is easily complicated by many identifiable factors including;

- For large coordinated structural levee improvement projects, typically a property tax increase is needed in order to finance the local cost share of the project cost. Because such projects take many years to complete, homeowners could be forced to pay both the high cost of flood insurance while the flood risk remains, as well as the annual tax needed to construct the improvements. As a result, homeowners will typically not be in favor of taxing themselves for the full amount of any long term savings.
- Land based financing funds many critical services within local communities and these services are competing for limited funding. For areas where existing taxes and assessments on properties are

already perceived as high, additional taxing capacity for flood improvements would be limited and compete against other services required by the community.

- As discussed above in Tax Rate and Infrastructure Burden Considerations (Section 11.2.11.2), some communities within California have adopted policies consistent with recommendations from the California Debt and Investment Advisory Commission (CDIAC). Not only will increased flood assessments compete with other services but the magnitude of a local flood assessment must also fit within the adopted policies of local communities that are attempting to efficiently manage debt within the context of State policies and guidelines.
- If future flood insurance rates exceed a homeowner's ability pay the cost of their taxes, mortgage and flood insurance, the full cost of the savings cannot logically be captured.
- Flood insurance rates do provide starting point for a community to make an informed decision about how much they would be willing to pay to fund flood improvements. However, a project specific rate study coupled with a well-planned and executed strategic public outreach campaign are also required to assess and determine a communities willingness and ability to pay additional taxes or assessments for flood control. Ultimately, flood insurance is just one of many factors to be taken into consideration.

11.2.11.4 New Development Funding

As discussed in Section 11.1.3, several of the Flood Region's sub-areas have previously approved and planned development projects identified. These areas include the Sutter Basin within Yuba City, Live Oak and Gridley; RD 784 within the Plumas Lake Specific Plan, and the City of Wheatland. In many cases a Development Impact Program is already in place to generate new funds to fund flood control improvements.

Sutter Basin

Within the Sutter Basin, the City of Yuba City and Sutter County have a Development Impact Fee Program in place to fund 200-Year flood control improvements within the basin. The Sutter Butte Flood Control Agency is currently working to develop a new fee program that would work in concert with its current Assessment District to direct funding from new development toward projects that would mitigate the risk of new development in the floodplain. While a fee rate has not yet been developed by SBFCA, to the extent the current levee impact fee rate was utilized for projects identified in the Sutter Basin, **Table 11-18** shows the potential funding capacity of the fee program.

RD 784/TRLIA

As further described above, TRLIA and Yuba County have utilized a development impact fee program to generate the local funding advanced by development interest and the County for TRLIA's levee improvement program. All impacts fee collected through this program into the future are dedicated to the retirement of debt incurred by Yuba County and YCWA, to credit for fees due on new units that previously advanced the fee, and finally to reimbursement to those private interests that advanced more than their fee obligation. **Table 11-18** shows the estimated funding capacity of the fee program, however, will be utilized to provide reimbursements rather than fund new projects.

Wheatland

As further described above, the City of Wheatland utilized a development impact fee program to generate the local funding needed to advance the Bear River Levee Improvement Project. Impacts fee collected through this program into the future are dedicated to reimburse those entities that advanced the project including the

City of Wheatland and various local development interests within the City. **Table 11-18** shows the estimated funding capacity of the fee program, however, this capacity will not be utilized to fund new projects.

Table 11-18. Development Fee Funding Capacity

<u>Zone</u>	<u>Projected New Development Units</u> <i>Table 11-10</i>	<u>Fee Per Unit</u>	<u>Total Fee Funding Estimate</u>
Sutter Basin	6,869	\$2,874	\$19,741,506
RD 784 / TRLIA [1]	8,000	\$15,900	\$127,201,778
Wheatland [2]	1,609	\$1,145	\$1,842,820
[1] A current advance funding and reimbursement program is in place that dedicates fees collected toward reimbursement obligations. [2] Not all fee collections are available to fund new projects.			
<i>Source: Yuba City, Sutter County, TRLIA, City of Wheatland</i>			

11.2.12 Funding Capacity Findings

Flood Region Counties exhibit a number of common demographic trends. Their populations have generally lower median household incomes and higher poverty rates than the State as a whole. Compared to California, educational attainment levels in Sutter and Yuba counties are relatively low, particularly for women. Unemployment in Sutter and Yuba counties is consistently higher than the statewide figure; unemployment is lowest around harvest season and peaks in February. As a result of the economic profile of the region, home values are generally lower and, as a result, taxing capacity is constrained.

As a result of the assessments districts formed by the flood control agencies within the Region, the vast majority of available funding capacity in the region has already been utilized to complete and service the existing flood control facilities currently in place and under construction. Only three of the Region’s sub-areas showed capacity to implement additional assessments given the approach to assessing capacity utilized. Many of the new development areas within the region have already advanced infrastructure utilizing fee capacity to fund completed work or work underway.

- **Finding 1: The Regions’ existing tax base has already implemented and utilized existing funding capacity to advance flood control improvements.** All of the six sub-regions have recently implemented or are currently implementing new assessments to fund flood control improvements and services. The Region has already utilized its existing assessments to complete or advance the projects identified in this plan.
- **Finding 2: The funding capacity of the limited new development within the Region has already been captured to advance flood control improvements.** Three of the six sub-areas currently have development impact fee programs in place to fund new levee improvements that have been recently completed or are underway. Two of those programs have already implemented advance funding programs essentially leveraging this capacity.
- **Finding 3: The Regions’ existing development, as a whole, has only marginal capacity to contribute additional funds to flood control improvements and services.** Major demographic characteristics in Flood Region counties include lower household incomes, lower housing values, and

higher unemployment levels. As a result, there is only limited capacity to impose additional taxes/assessments on existing residents and businesses.

- **Finding 4: The Region has a proven track record of generating local funding to leverage State funding.** The region has received and been committed a total of approximately \$460 million in State Funding since the passage of the Propositions 13, 1E & 84. Additional investments however are still needed. Local project proponents within the region should look toward ways of leveraging the previously completed investments toward future funding (taking advantage of credits) or look toward non-traditional local funding sources.

11.2.13 Funding Needs

11.2.13.1 Operations and Maintenance

Operations and Maintenance is a critical component of proper flood risk management. Throughout the region, as improvements have been planned and implemented, updates to Operation and Maintenance practices and budgets have been completed to address changes conditions of the levee system and to ensure that the investments made to improved system can be sustained. **Table 11-13** provides a list of the funding mechanisms implemented by flood control agencies within the region.

Details of the funding specific for O&M within the Region are described below.

- **RD 784/TRLIA** - As TRLIA completed structural improvements to the RD 784 levee system in 2009, an evaluation of the additional costs to operate and maintain the improved system was conducted which ultimately lead to the implementation of a new funding mechanism, the TRLIA Levee and Flood Control Facilities Assessment District. This district generates additional funding for O&M to ensure that the improved system could be certified and accredited.
- **Wheatland** - As RD 2103 completed improvements to the Bear River North Levee, it moved forward with a supplemental assessment district to provide additional funding for levee maintenance associated with the improved Bear River North Levee. This district generates additional funding for O&M to ensure that the improvements were certified and accredited.
- **RD 1001** - RD 1001's proposed new assessment is moving forward not only to cost share in projects through DWR's Flood System Repair Project, but also to supplement the districts cost of O&M.
- **Marysville** - The Marysville Levee Commission has formed two assessment districts to supplement the cost of Operations & Maintenance. The latest district includes an increased assessment fund improvements then transitions to funding O&M thereafter.
- **Sutter Basin** - Levee District 1 has implemented an assessment district to fund operations and maintenance.
- **RD 10** – Reclamation District has implemented a recent assessment district to fund operations and maintenance.

O&M funding for some LMA's within the Region however is still lacking. Within the Sutter Basin, a large portion of the Basin is maintained by the State through Maintenance Area's. As SBFCA moves forward with improvements to the Feather River West Levee, continued coordination with the State, to determine if there are any impacts to the costs associated with levee maintenance will need to take place. Currently SBFCA is evaluating the cost and benefit of consolidating LD1, LD9, MA3 and possibly other State maintained areas.

11.2.13.2 Area Projects

The following is a list of project identified within the Regional Plan with identified assumptions for State, Federal and Local cost sharing. The table is provided to provide an overall maximum limit of the funding need for State and Federal funding. This table will serve as guide to the State as it completes its Basin Wide Feasibility studies and update to the Central Valley Flood Protection Plan. This table will also serve as initial guide to local project proponents as they move forward to implement local projects. In other cases, the source of the State, Federal and local funding has not been identified. In some cases, the capacity to fund improvements and identified projects at a State or Local level may not be immediately available. As regional project proponents move forward with the implementation of projects, more detailed financing plans for these projects will need to be developed. The purpose of this project list is to outline the gross funding need from State, Federal and Local sources to support more detailed and larger planning efforts.

Feather River RFMP Project List

Project Characteristics							
PROJECTS AND DESCRIPTIONS		Federal Funding Source (Share)	State Funding Source (Share)	Local Funding Source (Share)	Federal (High End)	State (High End)	Local (Low End)
L BASIN SPECIFIC FLOOD RISK REDUCTION							
SUTTER BASIN							
L1	FRWLPI, Thermalito to Laurel Avenue,, achieve 200-year protection for urban areas, cost shared with State	USACE Creditable Project	EIP / UFRR (81%)	SBFCA AD (19%)	\$ -	\$ 226,800,000	\$ 53,200,000
L2A	Star Bend to Laurel Avenue	USACE Creditable Project	FSRP For Portion (85%) / Rural Program Balance	SBFCA AD (15%)		\$ 51,000,000	\$ 9,000,000
L2B	Additional projects to achieve 100-year flood protection for the southern portions of the basin, cost shared with the State, and collaborate with the State on comprehensive repairs or replacement of the Sutter Bypass East Levee. In parallel, repair critically damaged levees on the existing West Feather River levee and Sutter Bypass, and achieve a FEMA Ag Zone coupled with affordable insurance premiums.	USACE Lead Project / (65% + Credit from L1 to 95%)	Systemwide Improvement / FSRP (81% of Balance after Credit)	SBFCA AD (19% of Balance after Credit)	\$ 181,713,150	\$ 7,746,719	\$ 1,817,132
L3	Laurel Avenue Levee Seepage Remediation Study	Potential Credit	FSRP (85%)	SBFCA AD (15%)	\$ -	\$ 845,750	\$ 149,250
L4	Gridley Bridge Bank Erosion Repair Design	Potential Credit	YFFPP (100%)	N/A	\$ -	\$ 460,000	\$ -
L5	Oroville Wildlife Area Flood Stage Reduction Project (Design)		YFFPP (100%) Design	N/A	\$ -	\$ 1,658,800	\$ -
L6	Oroville Wildlife Area Flood Stage Reduction Project (Implementation)		UFRR (81%)	SBFCA AD (19%)	\$ -	\$ 3,397,950	\$ 797,050
CHEROKEE CANAL							
L1	Sedimentation Basin(s)						
L2	Levee improvements – Right Bank near Richvale						
L3	Bridge Crossing Improvement						
L4	Relief Weir, Left bank upstream of Richvale						
RECLAMATION DISTRICT 10- 24.75 mi							
L1	Seepage and under seepage site remediation (xx sites)		FRSP (85%)	Local AD / Other (15%)		\$ 263,500	\$ 46,500
L2	All-weather patrol road improvements (augment aggregate base, grading)		FRSP (85%)	Local AD / Other (15%)		\$ 788,906	\$ 139,219
L3	Improved rodent control and rodent burrow mitigation			Local AD Completed Overtime (100%)		\$ -	\$ 949,850
L4	Erosion protection at identified sites vulnerable sites		FRSP (85%)	Local AD / Other (15%)		\$ 855,301	\$ 150,935
L5	Improve drainage along levee landside toe to improve visibility, flood fight access, and levee stability		FRSP (85%)	Local AD / Other (15%)		\$ 631,125	\$ 111,375
L6	Evaluate, design, and construct levee improvements to achieve USACE project levee geometry and stability standards-- prioritized based on risk		Future Rural Program (70% - 85%)	Local AD / Other (30% - 15%)		\$ 149,308,450	\$ 26,348,550
MARYSVILL LEVEE DISTRICT (MLD)							
L1	Phase 2 levee improvements	USACE (95% - Credit from TRLIA Projects)	USACE/CVFPB Projects (70% of Remaining Costs)	Local AD / Other (30% of Remaining Costs)	\$ 37,240,000	\$ 1,372,000	\$ 588,000
L2	Phase 3 levee improvements	USACE (95% - Credit from TRLIA Projects)	USACE/CVFPB Projects (70% of Remaining Costs)	Local AD / Other (30% of Remaining Costs)	\$ 25,270,000	\$ 931,000	\$ 399,000
L3	Phase 4 levee improvements	USACE (95% - Credit from TRLIA Projects)	USACE/CVFPB Projects (70% of Remaining Costs)	Local AD / Other (30% of Remaining Costs)	\$ 3,705,000	\$ 136,500	\$ 58,500
L4	All-weather patrol road improvements (augment aggregate base, grading)			Local AD	\$ -	\$ -	\$ 50,000

Feather River RFMP Project List

Project Characteristics							
PROJECTS AND DESCRIPTIONS		Federal Funding Source (Share)	State Funding Source (Share)	Local Funding Source (Share)	Federal (High End)	State (High End)	Local (Low End)
LEVEE IMPROVEMENT PROJECTS							
TRLIA/ RECLAMATION DISTRICT 784							
L1	Phase IV—Complete WPRR levee improvements		EIP (70%)	Local Development Fees & Local GO Bonds (30%)		\$ 10,659,600	\$ 4,568,400
L2	Resolve ROW and encroachment issues for levees protecting urban areas			Local Development Fees & Local GO Bonds (if funding remains). Local TRLIA AD from future incremental assessments. Updated Development Fee.		\$ -	\$ 4,000,000
L3A	Yuba Goldfields - Phase 1 (100-Year)		YFFPP Feasibility Work (100%) / UFRR of Future Program (70%)	Local Funding - Development Fees & Local GO Bonds (30%)		\$ 4,200,000	\$ 1,800,000
L3B	Yuba Goldfields - Phase 2 (200-Year)		Future Program / UFRR (70%)	Local AD / Updated Development Fee / Other Local Funding (30%)		\$ 14,000,000	\$ 6,000,000
L4	Olivehurst Detention Basin (Construction completed. Action is to adopt as SPFC facility)			Local AD / Updated Development Fee / Other Local Funding (100%)		\$ -	\$ 50,000
L5	Yuba River South Levee ULDC Remediation		EIP (70%)	Local Development Fees & Local GO Bonds (30%)		\$ 1,050,000	\$ 450,000
WHEATLAND (2103, 817)							
L1	FSRP Identified Critical Repairs, Bear River north levee, RD 817 (setback Levee?)		FSRP (85%)	Future Local Mechanism to be Determined (15%)		\$ 6,630,000	\$ 1,170,000
L2	Dry Creek develop new hydrology		Completed by Others	Completed by Others		\$ -	\$ -
L3	Dry Creek south levee and San Joaquin ditch (3.9 mi) improvements feasibility study and environmental documentation to formulate preferred alternative approach		UFRR / Rural Studies (100%)			\$ 760,000	\$ -
L4	Develop more accurate FEMA 100-year maps for the existing developed area that floods from Dry Creek			Completed Over Time from Local Funding (100%)		\$ -	\$ 400,000
L5	Implement RD 2103 Dry Creek south levee improvements		Future Funding Program (70%) - Feasibility Study to Evaluate	Future Local Mechanism to be Determined (30%) - Feasibility Study to Evaluate		\$ 17,129,000	\$ 7,341,000
L6	This is a feasibility study to evaluate 100 year alternatives for repairs on the southern portion of the Dry Creek Levee and Bear River in RD 817 protecting the city of Wheatland.		YFFPP (100%)			\$ 797,000	\$ -
L7	Bear River north levee ULDC compliance evaluation.			Local Funding / Other Sources (100%)		\$ -	\$ 225,000
L8	Evaluate, design, and construct levee improvements to achieve USACE project levee geometry and stability standards-- prioritized based on risk; Remaining segments in RD 817		Future Funding Program (70%)	Future Local Mechanism to be Determined (30%)		\$ 70,040,600	\$ 30,017,400
L9	Evaluate, design, and construct levee improvements to achieve USACE project levee geometry and stability standards-- prioritized based on risk Remaining segments in RD 2103		Future Funding Program (70%)	Future Local Mechanism to be Determined (30%)		\$ 2,976,400	\$ 1,275,600

Feather River RFMP Project List

Project Characteristics							
PROJECTS AND DESCRIPTIONS		Federal Funding Source (Share)	State Funding Source (Share)	Local Funding Source (Share)	Federal (High End)	State (High End)	Local (Low End)
LEVEE IMPROVEMENT PROJECTS							
RD 1001 39.4 miles exterior levees							
L1	Address specific seepage, under seepage, erosion, and stability concerns for the Feather River levee, from the Natomas Cross Canal to the River Oaks Golf Course (Levee Unit 4, Levee Miles 5.2 to 13.4).		FSRP (85%)	Local AD & Asset contribution (15%)		\$ 4,335,000	\$ 765,000
L2	Re-rock levee crown patrol roads		FSRP (85%)	Local AD & Asset contribution (15%)		\$ 802,239	\$ 141,572
L3	Repair, replace, or abandon existing drains and pipes through the levees			Local AD overtime (100%)			\$ 86,680
L4	Improve erosion protection along the Bear River south levee		Future Rural Program (70%)	Future Local Funding (30%)		\$ 1,792,930	\$ 768,398
L5	Flood proofing Main Drain Pumping Plant		Stormwater IRWM Grant (70%)	Local Funding (30%)		\$ 350,000	\$ 150,000
L6	Construct a new pumping plant on the Cross Canal at end of Lateral 4		Stormwater IRWM Grant (50%)	Local Funding (50%)		\$ 500,000	\$ 500,000
L7	Replace or improve Main Drain pumping plant		Stormwater IRWM Grant (50%)	Local Funding (50%)		\$ 4,000,000	\$ 4,000,000
L8	Phased improvements to the RD1001 levee system to achieve 100-year FEMA levee protection						
L8-a	Natomas Cross Canal north levee		Future State Program (70%)	Local Funding Other Sources (30%)		\$ 86,714,600	\$ 37,163,400
L8-b	Feather River east levee, Cross Canal to River Oaks Golf Course		Future State Program (70%)	Local Funding Other Sources (30%)		\$ 244,830,600	\$ 104,927,400
L8-c	Bear River south bank, Yankee Slough to Pleasant Grove Road		Future State Program (70%)	Local Funding Other Sources (30%)		\$ 52,603,600	\$ 22,544,400
L8-d	Yankee Slough north and south bank, from confluence to Pleasant Grove Road		Future State Program (70%)	Local Funding Other Sources (30%)		\$ 40,282,900	\$ 17,264,100
L8-e	Bear River south bank, Pleasant Grove Road to high ground		Future State Program (70%)	Local Funding Other Sources (30%)		\$ 76,819,400	\$ 32,922,600
L8-f	Coon Creek Group Interceptor Canal Levee, Natomas Cross Canal to high ground		Future State Program (70%)	Local Funding Other Sources (30%)		\$ 9,452,100	\$ 4,050,900
CHANNEL IMPROVEMENTS							
C1	Nelson Weir removal or modification to reduce erosion and improve habitat		State funding responsibility to maintain design capacity (100%)			\$ 2,640,000	
C2	4 million CY of sediment removal Downstream of Nelson Weir (Corridor Management Plan)		State funding responsibility to maintain design capacity (100%)			\$ 40,000,000	
RESERVOIR STRUCTURAL IMPROVEMENTS							
R1	Bullard's Bar Outlets Modification		System Improvement (70% to 100%)	YCWA (0% - 30%) Through Coordination		\$ -	\$ -
R2	Bullard's Bar Tailwater Suppression		System Improvement (70% to 100%)	YCWA (0% - 30%) Through Coordination		\$ -	\$ -
RESERVOIR OPERATIONS							
	Forecast-Coordinated Operations for Yuba and Feather Rivers (F-CO)		State System Improvement (100%)			\$ 10,000,000	\$ -
	Forecast-Based Operations (F-BO)		State System Improvement (100%)			\$ 10,000,000	\$ -

Feather River RFMP Project List

Project Characteristics						
PROJECTS AND DESCRIPTIONS	Federal Funding Source (Share)	State Funding Source (Share)	Local Funding Source (Share)	Federal (High End)	State (High End)	Local (Low End)
ECOSYSTEM ENHANCEMENT AND RESTORATION OPPORTUNITIES						
Oroville Wildlife Area Multi-Benefit Project						
TRLIA Feather River Levee Setback Ecosystem enhancement		FESSRO Advanced Mitigation / Corridor Management Funding (80% - 100%)	Local Through Prior Investment Credit / Mitigation Funding (0% - 20%)		\$ 26,200,000	\$ -
LD1 Star Bend Levee Setback Ecosystem enhancement						
Feather River Wildlife Area - Abbott Lake Unit						
Laurel Avenue Levee Setback						
Feather River Wildlife Area - Nelson Slough Unit						
Sutter Main Canal relocation to enhance salmonid temperature control and improve maintenance efficiency (FERC Process)						
Expand Willow Island Recreation Area, Yuba City						
Purchase of Agricultural Easements						
Cherokee Canal						
Thermalito Afterbay Brood Ponds						
Hamilton Slough						
Live Oak Park						
Feather River Wildlife Area – O'Connor Lakes Unit						
Sutter Bypass Wildlife Area						
Sutter National Wildlife Refuge						
Lower Yuba River Native Fish Habitat Enhancement						
Sunset Weir						

DRAFT

11.2.14 Conclusions & Recommendations

The Feather River Region has made significant progress planning, funding and constructing flood improvements and related projects. The region has historically experienced significant loss as a result of past flooding and in the context of this loss, the local jurisdictions in the region have made flood control their number one priority and demonstrated this priority through historical and current investments.

Entities in the region have obligated themselves to pay well into the future for flood control improvements made over the last decade through the imposition of taxes and assessments and the issuance of debt. Entities within the region where new development will occur have obligated new development to pay for flood control improvements. Many LMA's within the region have identified and implemented new property assessments to supplement funding for operations and maintenance.

Additional improvements are needed to reduce the risk of flooding to appropriate levels and additional funding sources are needed to make those investments. While the region has minimal capacity to generate new funding, overtime, as current investments are amortized and identified projects move forward, evaluations of new funding sources can be made. As this takes place, the Region should seek out potential new funding sources and opportunities to continue to reduce risk.

The State has communicated a strong preference for funding multi-benefit projects. As noted in Section 5.1, as Local agencies formulate detailed design features and identify compatible multi-objective features, Local agencies and the State should work together to coordinate funding of multi-benefit projects. Securing funding from multiple sources to implement projects will provide the State and local agencies with another approach to create appropriate financial incentives to local agencies to formulate projects that achieve multiple benefits and reduce the costs required by the locals to complete flood risk reduction improvements.

11.2.14.1 Recommendations

Recent studies and reports providing analysis, commentary, and policy recommendations related to funding flood control have had a common theme emphasizing the importance of creating sufficient and sustainable funding sources to manage flood risk over time. DWR's California Flood Futures Report identifies existing funding constraints and presents recommendations for actions that could lead to new funding sources. PPIC's Paying for Water in California identifies and describes those same constraints with respect to local funding and presents recommendations that would help local entities address the funding gaps identified within the report. Ultimately, creating a sustainable funding source for flood control will require some action by the State legislature. This could include changes the current constitutional and statutory constraints on local entities to raise new revenues. The State and DWR should explore the following recommendations, some of which could be implemented in the near term. In the long term, the

State should continue efforts to implement recommendations made in recent studies focusing on long term stable funding for flood management.

- In the near term, DWR should provide funding to evaluate *and implement* new local funding mechanisms to generate the local cost share of projects consistent with the SSIA. The State has made it a clear priority to maximize the value of its investment by leveraging non-State funding sources. Directly funding efforts to establish new funding sources at the local level is consistent with this priority. The upfront costs associated with evaluating new projects, developing financing plans and implementing new funding mechanisms (within the current legal framework) could present a significant hurdle to many local entities. As the State is currently developing new programs which will provide funding for Feasibility studies, as a component of this effort, funding for financing plan implementation should be included.
- The State should continue to explore regional, basin or valley-wide funding districts that ensure that all beneficiaries of the flood control infrastructure pay. Any district should recognize the nexus of the flood control system to other essential public services such as safety, water supply and quality, recreation, and environmental protection. The current approach governed by Proposition 218 makes it too onerous to implement such a district at the local level. As a result, the current approach, which links the properties that receive special benefit to those within a district that will pay for the cost of the work performed, ignores the interconnectedness of the flood control system. A valley wide or regional assessment would need to be imposed not only on lands within a defined floodplain but also (i) on lands that drain into that floodplain, (ii) lands that would be in the 100-year floodplain absent flood control works, and (iii) potentially on lands that benefit from the lack of disruption that flood control seeks to offer.²⁰
- In the context of NFIP reform and rising flood insurance rates, the State could explore alternative flood or hazard insurance programs that could satisfy both federal lending requirements as well as provide structural mitigation to reduce risk. Various proposals have been discussed and questions arise whether such a program at a State level, absent heavy subsidy, could result in lower overall costs and more manageable constraints. However, one key aspect to a supportable and more sustainable program would be to ensure those required to purchase insurance represent all those properties that could potentially bear a cost as a result of a flood loss. This would include all those beneficiaries as discussed above.

In the Feather River Region, where the economic profile is predominately characterized by its rural and agricultural setting and the capacity to fund additional flood risk projects is constrained, in some cases, the most economical and financially feasible way to manage the flood risk may not be to construct additional improvements. Where a specific set of

²⁰ Aladjem, David R and Scott L. Shapiro, "Proposal for Revisions to California's Central Valley Flood Control System," Downey Brand, LLP, December 1, 2004.

improvements primarily benefits an agricultural land use and a supporting community; local, State and Federal interests may conclude that the benefits of structural improvements do not outweigh the costs. To resolve this issue, and to ensure that an appropriate level of flood risk is achieved in concert with the financial capability of the area, the State should support the Region's efforts to achieve flood insurance reform ensuring that the agricultural use of the area is sustainable.²¹

In some portions of the Feather River Region LMA boundaries do not include all properties which are provided flood protection from their facilities. The LMAs may consider action to annex such properties and thereby appropriately capture revenues which are currently foregone.

Finally, in the 2012 CVFPP the State articulated a strong commitment to encourage multi-benefit projects. As noted in Section 6.1, as Local agencies formulate detailed design features and identify compatible multi-objective features, Local agencies and the State should work together to coordinate funding of multi-benefit projects. Securing funding from multiple sources to implement projects will provide the State and local agencies with another approach to create appropriate financial incentives to local agencies to formulate projects that achieve multiple benefits and reduce the costs required by the locals to complete flood risk reduction improvements.

²¹ The specific actions related to a FEMA Agricultural Zone designation are further described within Section 9.3.1.

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Appendix A Regional Levees: Descriptions and Assessment Results

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Appendix B Maximum Water Surface Profiles

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Appendix C Regional Emergency Preparedness Inventory

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Appendix D DWR Sutter Yard Maintenance Documents and Issues

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Appendix E Rural LMA Work Group Issues Paper

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Appendix F MOU Regarding EIR/EIS and Planning Process for the Feather River West Levee Project

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Appendix G Public Outreach Process, including Summary of Meetings, Comments, and Responses

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