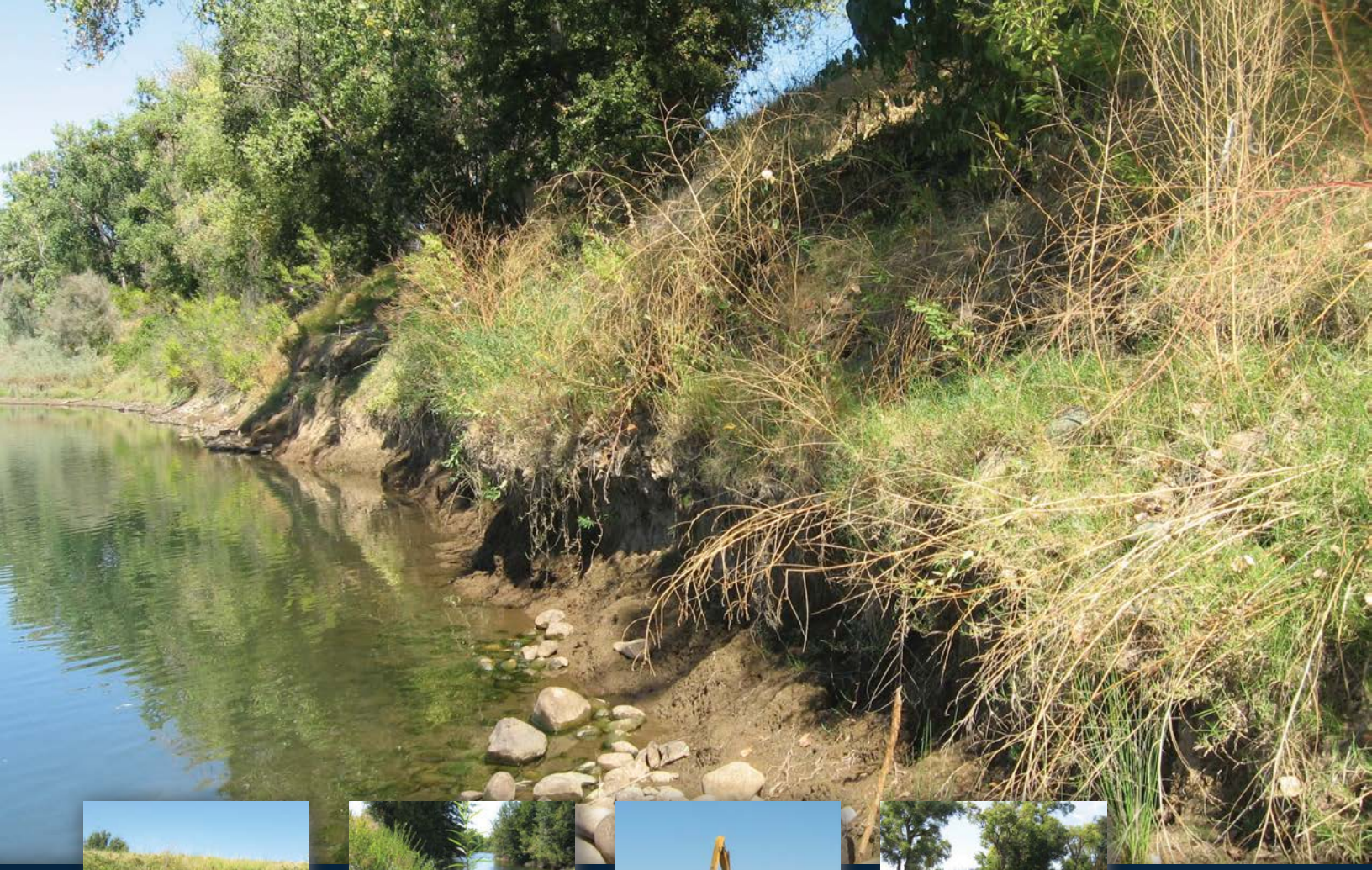










Post Authorization Change Report
Sacramento River Bank Protection Project
Sacramento River Basin, California

April 2020

US Army Corps of Engineers
Sacramento District

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EXECUTIVE SUMMARY

This Post-Authorization Change Report (PACR) for the Sacramento River Bank Protection Project (SRBPP) identifies the Federal interest in the SRBPP as modified by the Water Resources Development Act, Pub. L. 110-114, § 3031, 121 Stat. 1113 (2007) (WRDA 2007), which added 80,000 linear feet (LF) of bank protection to the original SRBPP Phase II project authorization. It recommends a policy compliant program for implementation of those 80,000 LF of bank repairs within economically justified sub-basins on sites chosen based upon the Site Selection and Implementation Process (see Appendix B). Construction would be subsequent to future site specific Design Documentation Reports (DDRs), site-specific environmental compliance documentation, and site-specific real estate addenda. Future economic updates will be included in Economic Reevaluation Reports (ERRs). Future cost updates will be included in Site Selection Reports (See Appendix B).

Erosion sites would be identified using engineering criteria. Repairs would be implemented following site-specific engineering design in accordance with the order of priority established during the site selection process, subject to real estate acquisition by the non-federal sponsor, the Central Valley Flood Protection Board (CVFPB) of the State of California, and with Federal cost-sharing.

The PACR recommends that the identification of floodplains resulting from levee failures in various sub-basins continue to be refined through further analysis of the hydrologic/hydraulic connectivity between sub-basins within the flood control system. On that basis, the economic analysis for the SRBPP would be updated to potentially identify additional sub-basins in which erosion protection work would be economically justified. If additional economically justified sub-basins are identified, then erosion sites in those sub-basins may be included in the Site Selection and Implementation Process (see Appendix B) with potential Federal cost-sharing.

The programmatic bank protection plan (PBPP) cost estimate for the 80,000 LF is $567 million at an October 2018 price level. This cost was extrapolated from the detailed cost estimate of bank protection at 15 representative erosion sites, composed of 7,204 LF, located in the economically justified sub-basins.

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LIST OF ACRONYMS

AEP	Annual Exceedance Probability
ASA (CW)	Assistant Secretary of the Army for Civil Works
BO	Biological Opinion
CEQA	California Environmental Quality Act
CVFPB	Central Valley Flood Protection Board
DDR	Design Documentation Report
Delta	Sacramento-San Joaquin Delta
DA	Department of the Army
DWR	California Department of Water Resources
EA / IS	Environmental Assessment/Initial Study
EC	Engineer Circular
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
EM	Engineer Manual
EP	Engineer Pamphlet
ER	Engineer Regulation
ERR	Economic Reevaluation Report
ERDC	Engineer Research and Development Center
ESA	Endangered Species Act of 1973
ETL	Engineer Technical Letter 1110-2-583
GRR	General Reevaluation Report
HTRW	Hazardous, toxic, and radioactive waste
IWG	Interagency Working Groups
IWM	In-stream Woody Material
LCA	Local Cooperation Agreement
LF	Linear Feet
LERRD	Lands, Easements, Rights-of- Way, Relocations and Disposals areas
MND	Mitigated Negative Declaration
MSWL	Mean Summer Water Level
NED	National Economic Development
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NOI	Notice of Intent
NOP	Notice of Preparation
O&M	Operation and Maintenance
PA	Programmatic Agreement

PACR	Post Authorization Change Report
PBPP	Programmatic Bank Protection Plan
Pub. L.	Public Law
PPA	Project Partnership Agreement
RD	Reclamation District
REP	Real Estate Plan
Pub. L. 93-252	River Basin Monetary Authorization Act of 1974
88 Stat. 49	River Basin Monetary Authorization Act of 1974
RM	River Mile
SHPO	State Historic Preservation Office
SPK	Sacramento District of the USACE
SRBPP	Sacramento River Bank Protection Project
SRFCP	Sacramento River Flood Control Project
State	State of California
USACE	United States Army Corps of Engineers
U.S.C.	United States Code
USFWS	United States Fish and Wildlife Service
VFZ	Vegetation Free Zone
WRDA	Water Resources Development Act

SECTION 1 — INTRODUCTION

The Sacramento River Bank Protection Project (SRBPP) is a continuing construction project, authorized by the Flood Control Act of 1960, to provide protection for the existing levees and flood control facilities of the Sacramento River Flood Control Project (SRFCP). The SRFCP consists of approximately 1,100 miles of levees plus overflow weirs, pumping plants, and bypass channels that reduce flood risk for communities and agricultural lands in the Sacramento Valley and Sacramento-San Joaquin Delta. The purpose of the SRBPP is to maintain the integrity of the SRFCP by managing flood risk throughout the system, and is accomplished by identifying erosion sites and implementing repairs on those sites.

This Post Authorization Change Report (PACR) is a decision document that confirms the Federal interest in the SRBPP as modified by the Water Resources Development Act, Pub. L. 110-114, § 3031, 121 Stat. 1113 (2007) (WRDA 2007), which added 80,000 linear feet (LF) of bank protection to the original SRBPP Phase II project authorization. Accompanying the PACR is a programmatic Environmental Impact Statement/Environmental Impact Report (EIS/EIR) that complies with the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA). Approval of this PACR is delegated to the South Pacific Division (SPD) per the Implementation Guidance for Section 3031 of WRDA 2007, June 6, 2008. No additional Congressional project authorization is required to construct the 80,000 LF.

Three purposes of this PACR are to: 1) document the history and status of the originally authorized Phase II 405,000 LF of the SRBPP; 2) report on significant changes in the scope of Phase II that are the result of modifications to the project authorized by Congress; and 3) provide a process for programmatic implementation of the additional authorized work and to support future budget requests.

The study objectives for the Phase II 80,000 LF PACR are as follows:

Assess potential Federal interest in the 80,000 LF authorized in Section 3031 of WRDA 2007

Develop a programmatic EIS/EIR and demonstrate that significant environmental impacts from bank protection can be avoided or offset

Support preparation of a new Project Partnership Agreement (PPA) for construction of the project with the non-federal sponsor

Provide a framework to supply data and information to support inclusion of SRBPP sites in future budgets

Set up a programmatic process in which to complete 80,000 LF of bank protection within the scope authorized by Section 3031 WRDA 2007 that reflects compliance with laws, regulations and policy.

SECTION 2 — DESCRIPTION OF AUTHORIZED PROJECT

2.1 STUDY INFORMATION

The SRBPP is a long-range construction project to identify significant erosion problems, prioritize erosion sites, and design and construct bank protection. Corrective measures are applied only to affected banks and levees that are part of the Federal SRFCP. The SRFCP is located along the Sacramento River from Elder Creek near Tehama to its confluence with the San Joaquin River in the Sacramento-San Joaquin Delta (Delta). The SRFCP includes a number of tributaries, sloughs and bypass channels. Figure 1 is a map of the Sacramento River Watershed and shows the extents of the SRFCP. The SRBPP area coincides with the levees and other features of the SRFCP. The SRBPP area extends south to north along the Sacramento River from the town of Collinsville at River Mile (RM) 0 upstream to Chico at RM 194, and includes reaches of the lower Elder and Deer Creeks. The SRBPP project area also includes Cache Creek, the lower reaches of the American River (RM 0-23), Feather River (RM 0-61), Yuba (RM 0-11) and Bear River (RM 0-21), as well as portions of the Three Mile, Steamboat, Sutter, Miner, Georgiana and Cache Sloughs. Figure 2 is a map of the SRFCP levees and indicates the potential extent of bank protection.

The SRBPP has been a responsive and effective tool for non-emergency erosion protection for the SRFCP facilities. Annual inspections monitor bank erosion that could threaten levees. The observations are used to rank erosion sites and design and construct bank protection to preserve the viability and integrity of the SRFCP levees. The SRBPP has the flexibility to periodically prioritize bank protection, and construct bank protection at those locations where erosion protection is essential and economically feasible. Responsibility for implementation is shared between the USACE and non-federal sponsor, the Central Valley Flood Protection Board (CVFPB). The USACE is responsible for planning, design and construction of the bank protection. The CVFPB is responsible for providing all lands, easements, rights-of-way, and relocations, and for operation and maintenance (O&M) of the completed project.

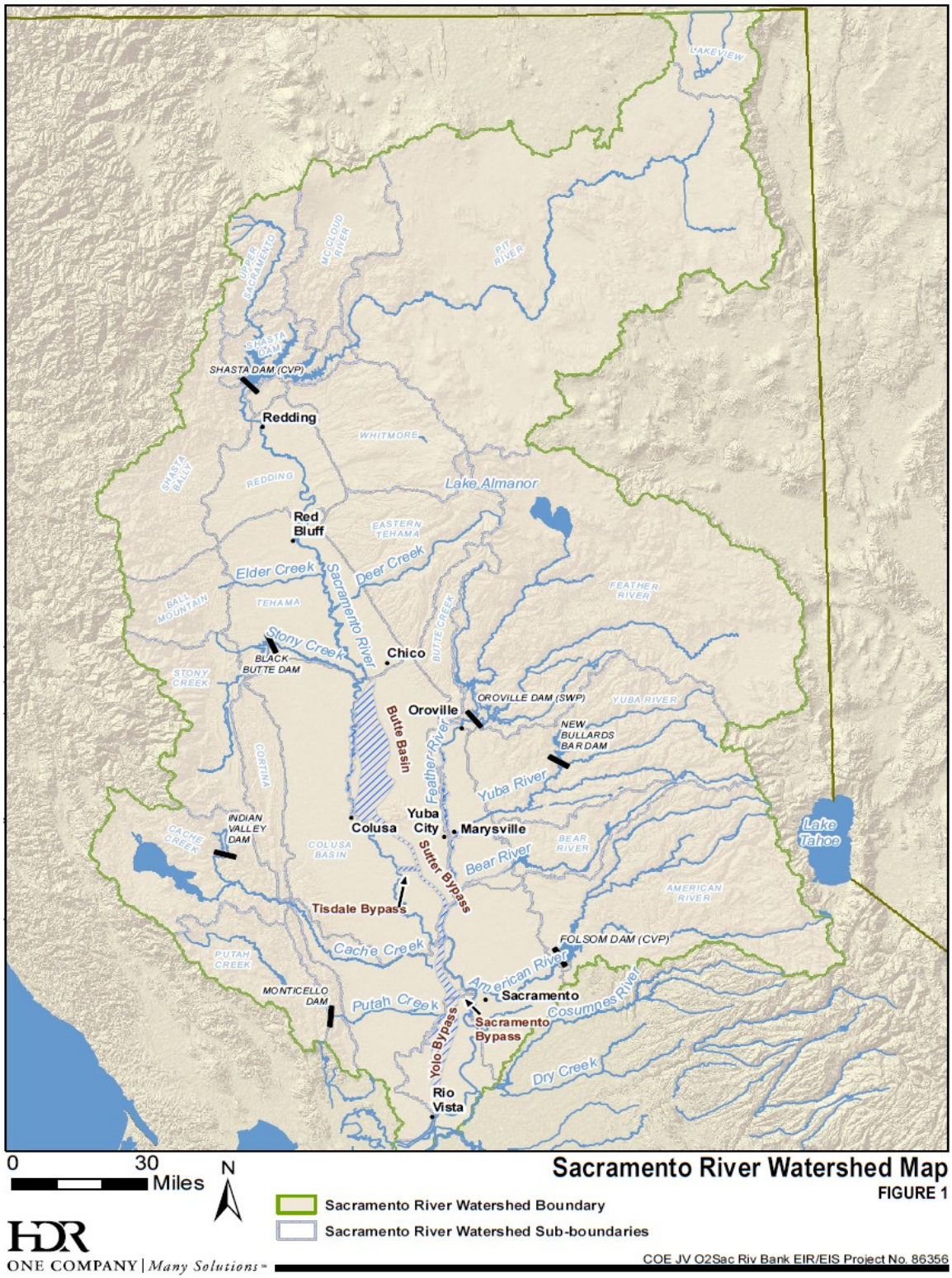


Figure 1. Sacramento River Watershed Map

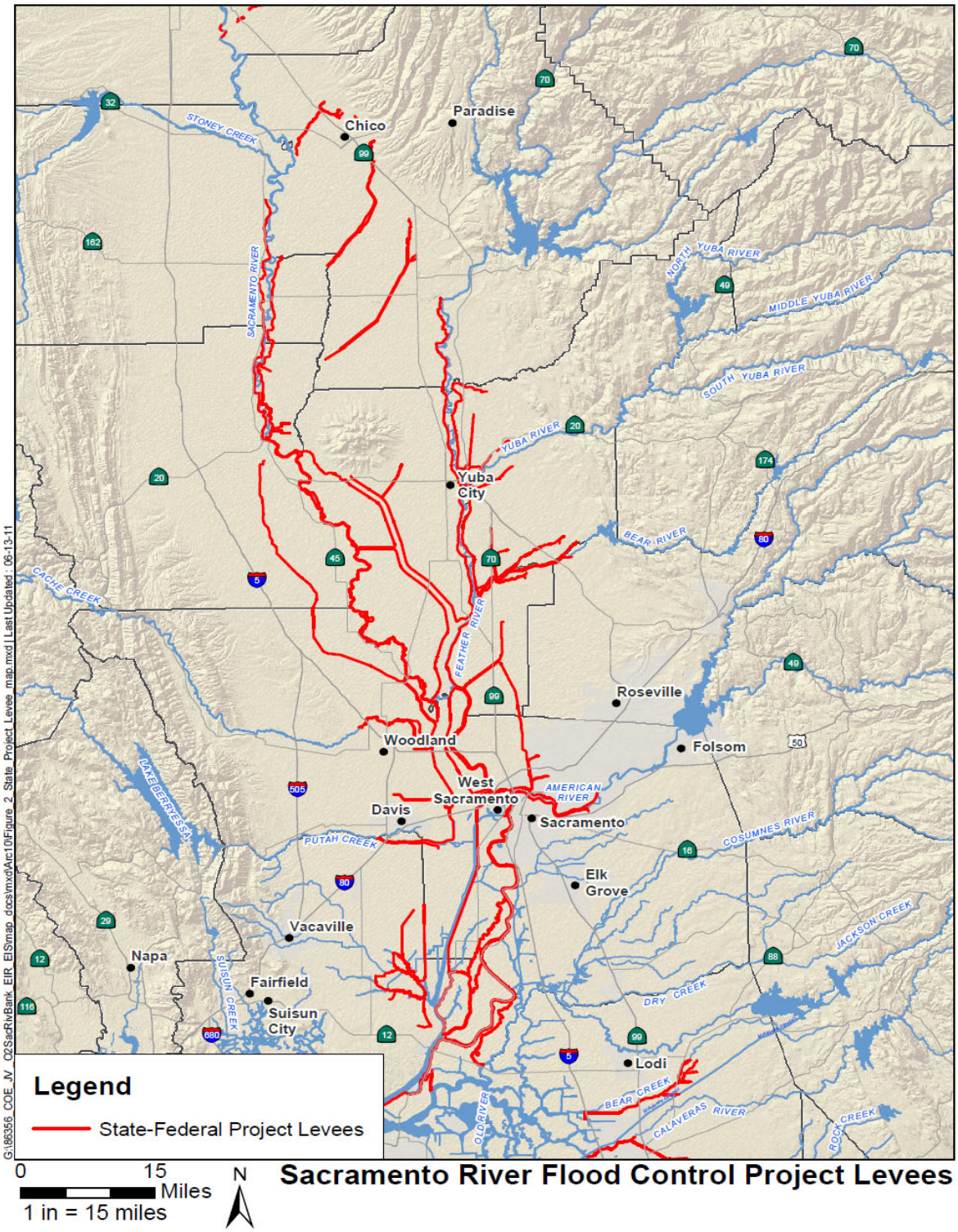


Figure 2. Sacramento River Flood Control Project Levees

A 2007 field reconnaissance identified, rated, and ranked 152 erosion sites along the SRFCP levees. The rankings were based on four methodologies that used various combinations of 16 physical factors and two economic factors. Based on the 2007 rankings, a 2009 Alternatives Report prepared for USACE selected 107 high priority sites, with a total length of approximately 80,000 LF, to evaluate for this PACR as representative sites. One site was subsequently eliminated during further evaluation. The process used to identify and select specific erosion sites to include in the evaluation is detailed in Appendix A, Sections 1.3 and 4.1. The 106 potential sites for repair were used as a representative sample set for the composition of the 80,000 LF, and to conduct programmatic assessments of costs, economic benefits and environmental impacts. The entire group of 106 sites is referred to as the priority site inventory (PSI) in this PACR.

Economic analysis was performed comparing the risk associated with the existing conditions of degraded levees to the with-project conditions (erosion issues addressed) in order to estimate project benefits. This analysis used data collected in the field as well as existing data/information as much as possible and where deemed appropriate. Existing data/information that were used include floodplains, hydrologic/hydraulic data, and geotechnical data. The Hydrologic Engineering Center's Flood Damage Analysis software (HEC-FDA, v1.4.2) was used to model the without-project and with-project conditions and to estimate benefits within a risk analysis environment. The economic analysis was performed in accordance with the USACE Engineer Regulations, ER 1105-2-100 (Planning Guidance Notebook) and ER 1105-2-101 (Risk Analysis for Flood Risk Management Studies).

For the purpose of the economic analysis, the study area was composed of 50 basins, of which only 24 were evaluated due primarily to the lack of existing erosion site(s) in the other basins. Currently, erosion protection work in seven of the 24 evaluated sub-basins is considered economically justified, with a benefit-to-cost ratio above unity. Those seven economically justified basins (EJB) contain 15 erosion sites composed of 7,204 LF from the PSI. The 15 sites in the seven EJBs are referred to in this PACR as the justified PSI (JPSI). The cost of providing erosion protection at the 15 sites is estimated to be approximately $51 million. The programmatic costs for the authorized total of 80,000 LF were estimated through extrapolation using the detailed cost estimate for the JPSI. The PSI was also used to assess environmental impacts for the programmatic EIS/EIR associated with the PACR to encompass potential future work outside of the current justified sub-basins. As erosion sites and bank protection measures for these sites are identified during project implementation, site-specific designs, cost estimates, economic analyses, and NEPA documents will be prepared for each DDR (See Appendix B).

The programmatic bank protection plan (PBPP) is the proposed implementation plan for the SRBPP Phase II 80,000 LF. The PBPP is the total series of procedures employed to identify, evaluate, select, design, approve and construct bank protection at specific erosion sites. The site selection and implementation process that will be used for future assessments is summarized in the following sections and described in more detail in Appendix B (Site Selection and Implementation) to this PACR. Although the future site selection process would use criteria similar to those used to select the 106 representative sites evaluated in this PACR, the future site selection process detailed in Appendix B will not be the same as the process used in the 2007 site rankings described above.

The selection-implementation process used in subsequent assessments to identify erosion sites, prioritize these sites, and design and construct bank protection at these sites will be similar to the process used in this PACR. Site-specific documents will include environmental compliance reports, DDRs, Real Estate Plans (REPs), and Economic Reevaluation Reports (ERRs). Procedures include erosion site reconnaissance, site selection, and analyses that are compliant with laws, regulations, and policies associated with each discipline (e.g., engineering, environmental, economics, real estate, etc.).

The PBPP consists, in summary, of the following major actions:

Construct up to the authorized 80,000 LF of erosion protection features within the economically justified sub-basins on sites chosen based upon the Site Selection and Implementation Process for Bank Repairs (see Appendix B). Erosion sites will be identified during field visits using engineering criteria and prioritized using the site selection process. Site-specific design will be completed according to the priority ranking of the sites. A DDR will be prepared for each group of erosion sites, with site-specific designs and tiered environmental compliance documentation, prior to construction. Construction will be subject to real estate acquisition by the State of California and cost-sharing.

Update the economic analysis for the SRBPP to potentially identify additional sub-basins in which erosion protection work would be economically justified. SPK will continue to refine the geotechnical levee fragility curves and the floodplains resulting from these geotechnical refinements through further analysis of the hydrologic/hydraulic connectivity between sub-basins within the system. If additional economically justified sub-basins are identified, then erosion sites in those sub-basins may be included in the Site Selection and Implementation Process (see Appendix B) with potential Federal cost-sharing.

The SRBPP Phase II 80,000 LF will begin implementation upon approval of the PACR, execution of a cost-sharing agreement, and receipt of Federal and non-federal funding. The cost-sharing agreement will be a new PPA executed between the USACE and the CVFPB, the non-federal sponsor. Sites will be implemented in the order of priority determined by the Site Selection and Implementation Process (see Appendix B), subject to real estate acquisition constraints, following site-specific environmental compliance documentation and engineering design. Any work the non-federal partners decide to complete that is not selected through the Site Selection and Implementation Process (e.g., is not within the current or future economically justified sub-basins), will not be eligible for SRBPP Federal funding and, unless considered to be routine maintenance, will need to be permitted under Section 408.

A project challenge is the management of riparian vegetation that exists on levees and banks. For the project to be acceptable, it must comply with current USACE vegetation management policy (VMP) as defined in Engineer Pamphlet (EP) 1110-2-18 (Guidelines for Landscape Planting and Vegetation Management at Levees, Floodwalls, Embankment Dams and Appurtenant Structures), the draft Policy Guidance Letter (PGL) on Process for Requesting a Variance From Vegetation Standards for Levees and Floodwalls (February 17, 2012), and the Implementation Guidance for Section 3013 of WRRDA 2014, Vegetation Management Policy (October 19, 2017). The preliminary designs for the PSI demonstrate that bank protection can be compliant with USACE VMP as described in EP 1110-2-18. The environmental evaluation of the PSI shows that significant biological impacts, including loss of habitat for endangered migratory fish species present in the Sacramento River system, can be mitigated. Thus, the PACR demonstrates, on a programmatic level, the amount of impacts that could be expected from 80,000 LF of bank protection, and how the SRBPP could comply with environmental regulations and the USACE VMP, and also meet the Endangered Species Act (ESA) requirements.

2.2 SACRAMENTO RIVER BANK PROTECTION PROJECT BACKGROUND

The SRBPP reduces flood risk throughout the SRFCP area by repairing erosion sites. As described in the Implementation Guidance for Section 3031 of the WRDA of 2007, the SRBPP "is an on-going bank protection project that provides for a continuing long-range program of bank stabilization and erosion control to maintain the integrity of the Sacramento River Flood Control Project through bank protection and set-back levees." The type and timing of the bank protection increments as well as the long-range, programmatic nature of the SRBPP distinguishes it from both normal operation and maintenance (O&M) activities, which are solely the responsibility of the non-federal sponsor, and typical civil works projects in which a cost-shared project is constructed within a limited period of time and then subsequently operated and maintained by the non-federal sponsor. The SRBPP is a shared effort between the federal government (planning, designing, and constructing) and the non-federal sponsor (real estate and O&M activities) that takes place on a continual basis over a period of many years.

To illustrate the extent of erosion, a map of the 201 bank erosion sites identified in the 2012 inventory is shown in Figure 3. As additional information, the 2017 inventory identified 192 erosion sites totaling 356,000 LF. Bank protection occurs either on the waterside bank (also referred to as "berm"; for this report "berm" and "bank" are used synonymously) or the levee if there is no bank. Critical sites, which are identified as having eroded to the extent that there is a risk of a levee breach during the next large flood event, must continue to be protected to maintain the integrity of the SRFCP. The SRBPP usually addresses erosion damage using fix-in-place stone placement on the bank or levee. The SRBPP does not include other levee corrective measures such as seepage and cutoff walls, raising low spots along the levee crests, improving slope stability, correcting seismic deficiencies, or reducing overtopping risk.

The vast majority of bank protection consisted of stone protection (rip-rap revetment) with various forms of environmental mitigation. In a few cases, setback levees meeting current design standards were constructed to decrease erosion potential and loss of habitat. The work done for the SRBBP under Phase I and II is summarized in the *Baseline Accomplishments Report, Sacramento River Bank Protection Project Phase I and II Summaries (*May 2011), which is available from the USACE Sacramento District upon request.

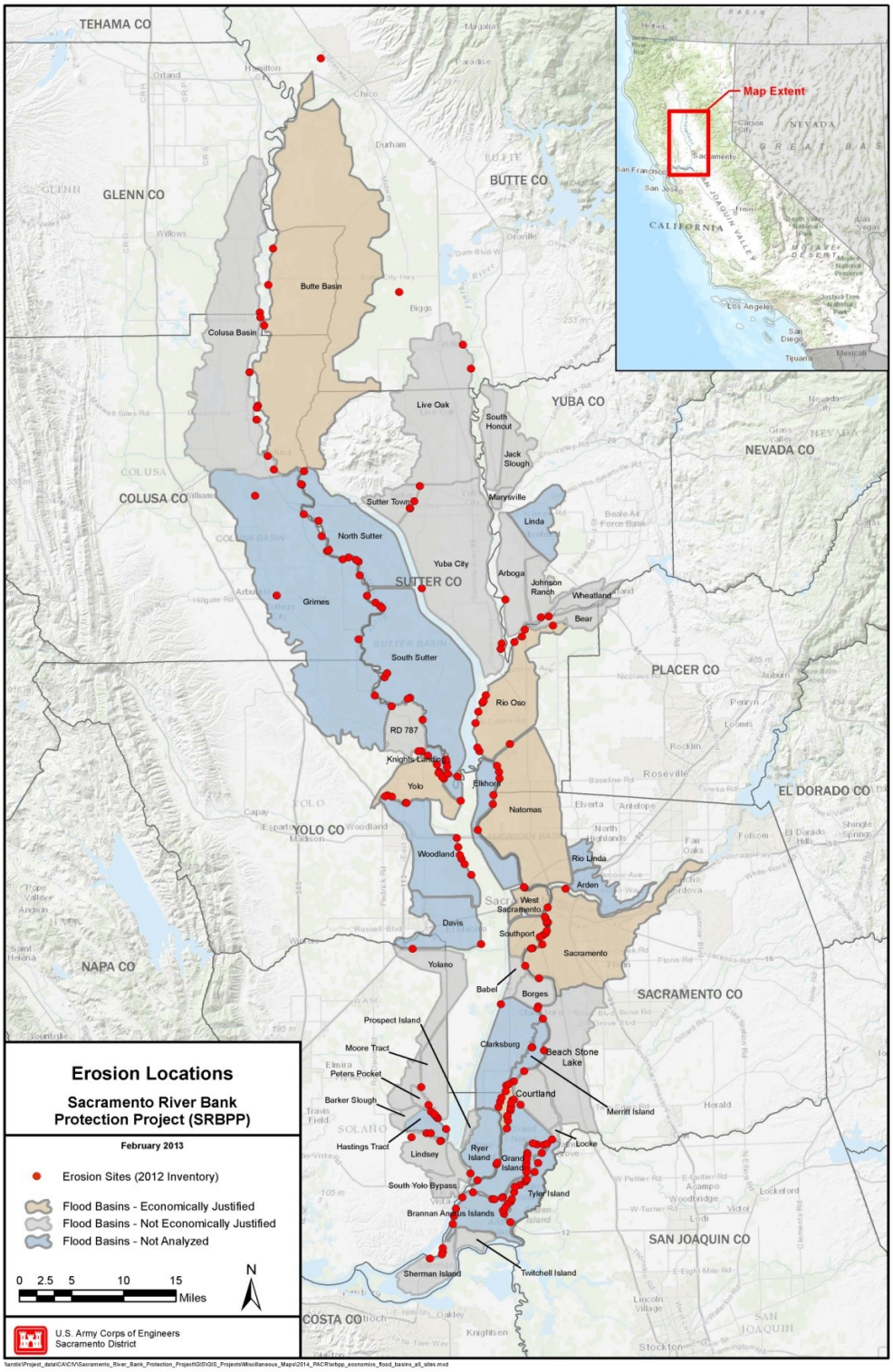


Figure 3. Identified Erosion Sites within the Sacramento River Bank Protection Project

2.3 DESCRIPTION OF THE PHASE II 80,000 LF PROGRAMMATIC BANK PROTECTION PLAN

2.3.1 PROGRAMMATIC EVALUATION APPROACH TO ADDITIONAL PHASE II 80,000 LF

The PSI identifies 106 erosion sites on the SRFCP that total roughly 80,000 LF and are used as a representative sample for economic and environmental evaluation of the Phase II 80,000 LF. Each of the erosion sites in the PSI was evaluated to determine the most technically sound repair measure for that specific site. The technical evaluation included aspects such as hydrology, levee stability, available real estate, repair footprint for a vegetation free zone, impacts to the levee profile, and the measure that is most sensitive to the existing environment and associated features that would improve habitat value. A design and cost estimate was then developed for each site.

It is not possible to describe a definitive plan that specifies which bank protection measures will be constructed at which locations. This is because erosion is a dynamic function such that critical erosion sites change with each flood season in an unpredictable manner. Erosive flows may reduce banks, increasing the risk of flooding from levee failure, and increasing the urgency of bank protection for that location. Some erosion sites may become less critical due to changes in hydraulics and sedimentation or implementation of bank repairs. The PSI is considered a reliable representation of what could be constructed. The specific locations where repairs take place may change, but the overall breadth and scope of the project and measures used should not change. A more detailed description of the development of the PSI is presented in Appendix A, Section 2.

Based on available data, the economic analysis of the PSI identified seven economic areas (sub-basins) within which erosion repairs are currently economically justified (i.e., have a benefit-to-cost ratio above unity). Of the 106 erosion sites identified in the PSI, 15 sites are located in the economically-justified basins (EJB). These 15 sites were used to estimate the costs and benefits of implementing the PBPP in the seven economic impact areas (sub-basins) where these sites are located. The estimated cost for implementing the Phase II 80,000 LF is based on the average cost per LF for the bank protection at the 15 sites in the JPSI. At this time, it is expected that specific bank protection selection, analysis, design and construction will be done on an annual basis and reported in site-specific supplemental DDRs to be approved by the Sacramento District and site-specific tiered environmental documentation. (A more detailed description of the Site Selection and Implementation Process is in Appendix B.) The implementation process provides the flexibility to respond to year-to-year changes to the erosion problems arising along the SRFCP. Prior to 1990, an average of approximately 8,000 LF of bank repairs were constructed annually; however, starting from 1990 the amount of bank repairs has decreased to an average of about 3,300 LF/year (Figure 13) due to complications with designs and consultations with resource agencies related to the Endangered Species Act (ESA). After this PACR is approved, the average annual amount of bank repairs is expected to return to higher levels because there will be fewer unresolved issues related to ESA compliance and additional repair sites will be included in the design process for potential construction. Based on the historic, pre-1990 average of 8,000 LF per year, it is estimated that it would take at least ten years to implement the additional Phase II 80,000 LF; but based on the post-1990 average of 3,300 LF per year, the physical construction period would be about 24 years. The organizational level at which approvals are made could change in the future, but that is not expected to substantively change the site selection process or result in different impacts.

The SRBPP is defined and described using programmatic products, which are described below.

This PACR, the EIS/EIR, and the associated Appendices describe a programmatic bank protection plan to implement the 80,000 LF and evaluate the economic and environmental effects of that plan. The PACR recommends one implementation process with multiple design alternatives. Selection of a particular design alternative for specific erosion sites will be determined in the future. NEPA and CEQA generally require that an environmental document (EIS/EIR) consider a range of alternatives that would attain most of the basic project purpose, need and objectives while avoiding or substantially lessening adverse project impacts. The design alternatives present a range of possible impacts depending upon the specific decisions to be made using the implementation process. The environmental document also analyzes a no-action or no-project alternative.

In the EIS/EIR, five alternatives with five sub-alternatives are analyzed in addition to a no-action alternative. The five action alternatives (Alternative 2A-6A) apply site-specific bank protection measures (design alternatives) to each of the 106 representative erosion sites in the PSI. The five sub-alternatives (Alternatives 2B-6B) apply the same site-specific bank protection measures to representative erosion repair sites of up to 80,000 LF within EJBs only. The site-specific bank protection measure applied to each erosion site varies from one alternative to another. The Preferred Alternative identified in the EIR/EIS is Alternative 4A – Habitat Replacement. Alternative 4A was identified as the Preferred Alternative because it consists of the site-specific design measures that a preliminary engineering evaluation identified as the most suitable for most sites based upon engineering factors, costs, and effects on habitat. Therefore, Alternative 4A is believed to provide the best indication of the type and magnitude of the environmental effects most likely to result from implementation of the programmatic bank protection plan. Under this PACR, Alternative 4A will be implemented only in the current or future EJBs. Additional details and analysis can be found in the EIS/EIR.

2.3.2 SITE SELECTION AND IMPLEMENTATION PROCESS

The site selection and implementation process describes the process by which bank protection sites will be identified, prioritized, and selected, and how bank protection repairs for those sites will be designed and constructed. The process includes annual erosion surveys and rankings, and the preparation of site-specific DDRs, site-specific tiered environmental documentation, and site-specific Real Estate Addendums. Additional information on the site selection and implementation process can be found in Appendix B. Implementation will be on-going throughout the duration of the 80,000 LF.

Under the site selection and implementation process, each DDR for a cohort of erosion sites will address and comply with the most current applicable USACE engineering guidance at the time that it is prepared, including the most recent guidance regarding risk-informed decision-making, climate change, and relative sea level rise. The most appropriate hydrology available will be used in developing each DDR. Each DDR will be subject to technical review to ensure compliance with the current guidance.

2.3.3 REAL ESTATE PLAN

The REP describes the process that will be used to acquire the necessary rights of way and relocations. The information listed in the REP, Exhibit D - Site Specific Real Estate Inventory Checklist will be updated by USACE as sites are identified for construction. At this time, it is expected that the addenda updating the REP will be reviewed and approved at the Division level. The Real Estate addenda will better define the impacted parcels, costs of acquisition, schedule, etc. More information about the real estate process for the SRBPP can be found in Appendix C.

2.3.4 DEVELOPMENT OF BANK PROTECTION MEASURES WITHIN THE PRIORITY SITE INVENTORY

Development of the priority site inventory (PSI) followed a rational process to achieve a technically sound and complete analysis. The results of the PSI are bank protection measures that will be applied to the erosion sites throughout the project area, taking into account the unique characteristics of each site. These measures are described in the next section as well as in Appendix A, Section 4.

2.3.5 BANK PROTECTION MEASURES

Bank protection measures are generic, conceptual designs to accomplish erosion protection objectives. Historically, the most often employed measure has been rip rap revetment (stone protection), but the measures used have evolved and become more diverse through the many years of bank protection implementation. Additional measures have been developed to avoid or minimize significant environmental impacts such as loss of riparian vegetation and fish habitat.

The existing bank and levee conditions and availability of land determine the most appropriate and least-cost measures for each site (See Appendix A, Section 4**,** and EIS/EIR for analysis). The measures are described below and shown as graphical cross sections in Figures 4 through 10. The construction would include bringing levee slopes into compliance with USACE standards; this is depicted as a dotted red line on the figures. Other measures or variations may be designed and constructed during implementation.

Measure 1: Setback Levee

A setback levee (Figure 4) entails constructing a new levee landward of the existing levee to avoid construction in the channel or riparian areas. The setback levee is most efficient for locations where a large number of erosion sites are located near each other. In these instances multiple erosion sites can be repaired by a single setback levee. Analysis in the Engineering Appendix (Appendix A, Section 4) shows that ten erosion sites could be repaired by constructing a setback levee. The SRBPP authorization includes bank protection and setback levees.

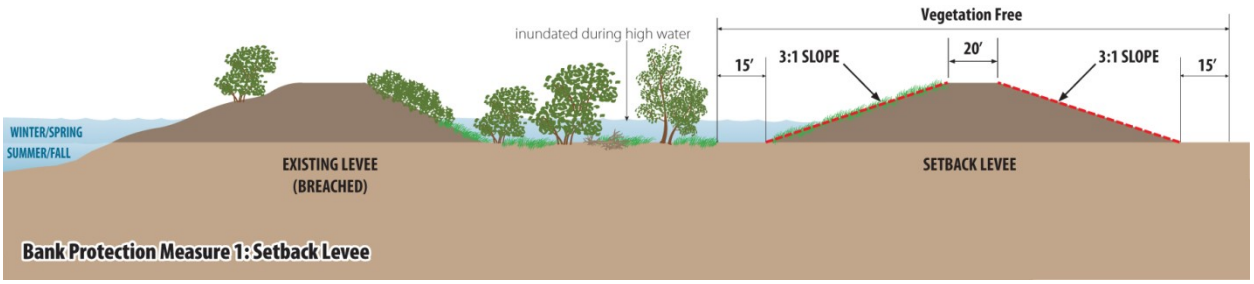


Figure 4. Measure 1 Setback Levee or Rip Rap Revetment

Measure 2: Bank Fill Stone Protection with No On-Site Vegetation

This measure (Figure 5) involves repairing erosion along the banks and/or levees with stone protection (revetment). Vegetation is limited to native grass within the vegetation free zone (VFZ), which is on the levee slopes and 15 feet out from the theoretical levee toe. This measure is most applicable in areas with constrained space for construction and vegetation. Analysis in the Engineering Appendix shows that 12 erosion sites could be repaired by installing stone protection with no on-site vegetation.

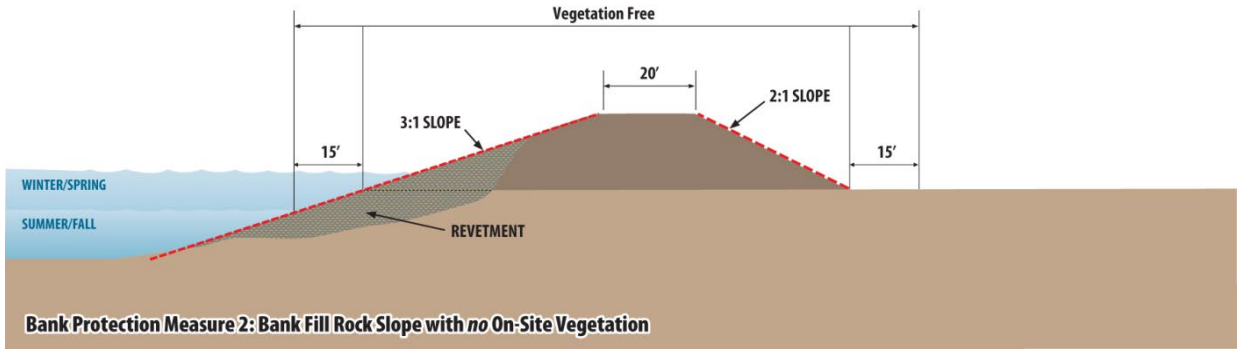


Figure 5. Measure 2 Bank Fill Stone Protection with No On-Site Vegetation

Measure 3: Adjacent Levee

This measure (Figure 6) involves constructing an adjacent levee and utilizing the landward portion of the existing levee. This would allow existing vegetation to remain on the waterside of the levee and would also allow for installation of in-stream woody material (IWM) and riparian vegetation outside of the VFZ on the existing levee and/or bank. This measure is most applicable to areas where the bench is narrow or non-existent. Like the setback levee, the adjacent levee can be used for areas where a large number of erosion sites are located close to each other. Analysis in the Engineering Appendix shows that 15 erosion sites could be repaired by constructing an adjacent levee. The SRBPP authorization includes bank protection and set-back levees; adjacent levees are a subcategory of setback levees.

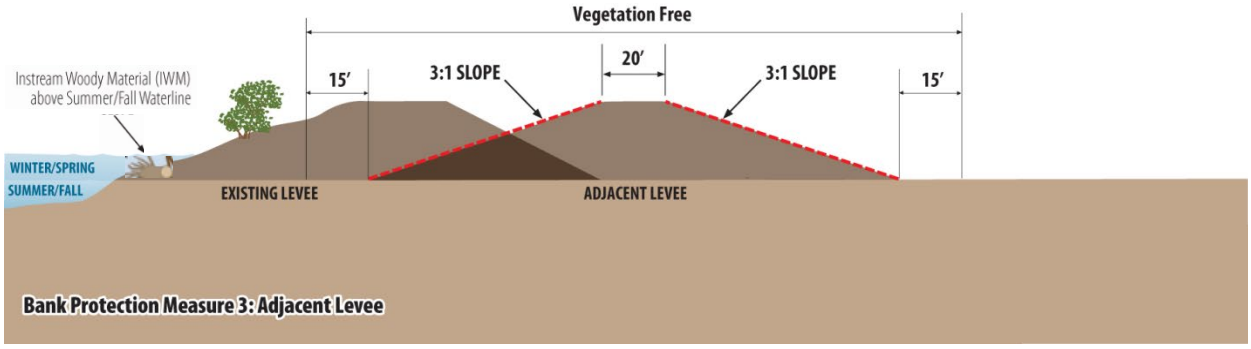


Figure 6. Measure 3 Adjacent Levee

Measure 4: Riparian and Wetland Banks with Re-vegetation

This measure consists of three variations that are described below and involve placing stone protection and construction of a waterside berm to repair erosion.

Measure 4a: Riparian Bank with Re-vegetation and IWM above Summer/Fall Waterline

This measure (Figure 7) installs a waterside berm with soil-filled stone protection in the areas of erosion to above the mean summer water level (MSWL). Stone protection would be installed on areas of the levee slope above the MSWL. The berm would support riparian vegetation and would allow placement of IWM above the MSWL. Analysis in the Engineering Appendix has not shown any erosion sites that could be repaired by Measure 4a.

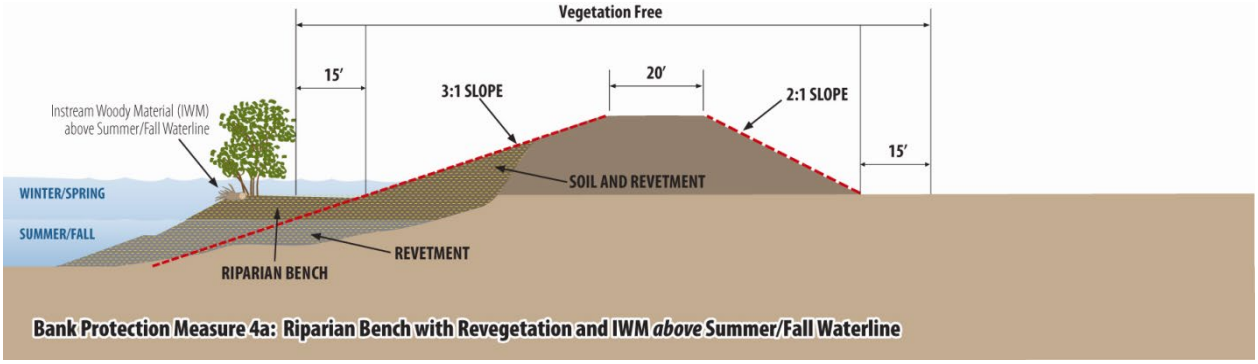


Figure 7. Measure 4a – Riparian Bench with Re-vegetation and IWM above Summer/Fall Waterline

Measure 4b: Riparian Bench with Re-vegetation and IWM above and below Summer/Fall Waterline

This measure (Figure 8) installs a waterside berm with soil-filled stone protection in the areas of erosion to above the MSWL. Stone protection would be installed in areas of the levee slope above the MSWL. The berm would support riparian vegetation and would allow placement of IWM above and below the MSWL. Analysis in the Engineering Appendix has not shown any erosion sites that could be repaired by Measure 4b.

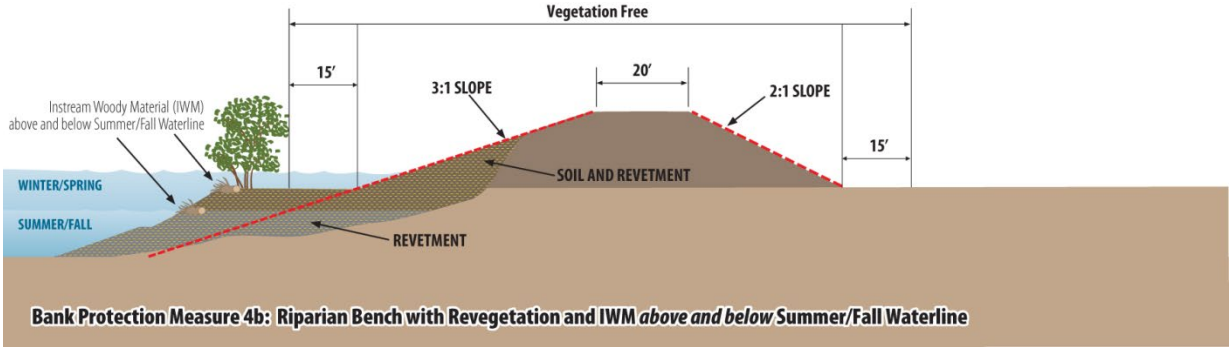


Figure 8. Measure 4b – Riparian Bench with Re-vegetation and IWM above and below Summer/Fall Waterline

Measure 4c: Riparian and Wetland Benches with Re-vegetation

This measure (Figure 9) involves installing a wetland bench and a riparian bench with soil-filled stone protection in the areas of erosion. The riparian bench would be installed to above the MSWL. The wetland bench would be installed to below the MSWL. Analysis in the Engineering Appendix has shown that two erosion sites could be repaired by riparian and wetland benches with re-vegetation and IWM above and below the Summer/Fall waterline.

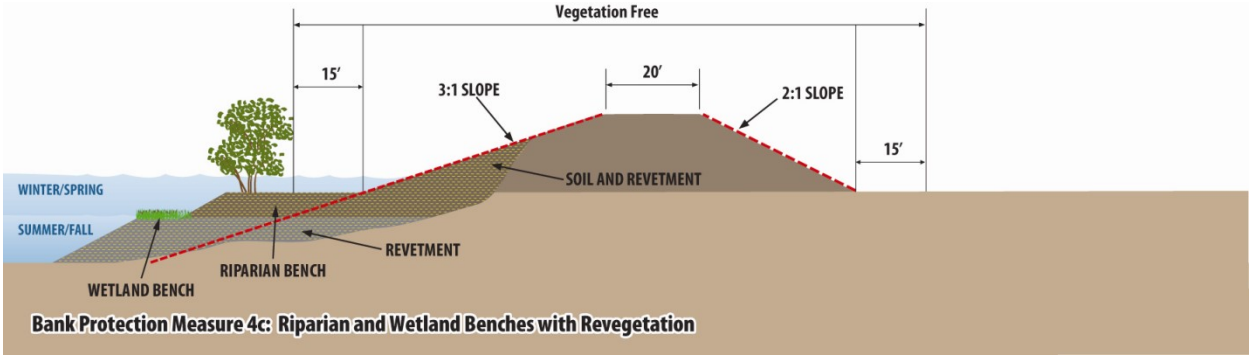


Figure 9. Measure 4c – Riparian and Wetland Benches with Re-vegetation

Measure 5: Bank Fill Stone Protection with On-Site Vegetation

This measure (Figure 10) involves filling the eroded portion of the bank with stone protection along the levee and/or bank slope. Vegetation would be limited to native grass within the VFZ. Six inches of soil cover would be placed on the stone protection to promote on-site vegetation. Analysis in the Engineering Appendix has not shown any erosion sites that could be repaired by Measure 5.

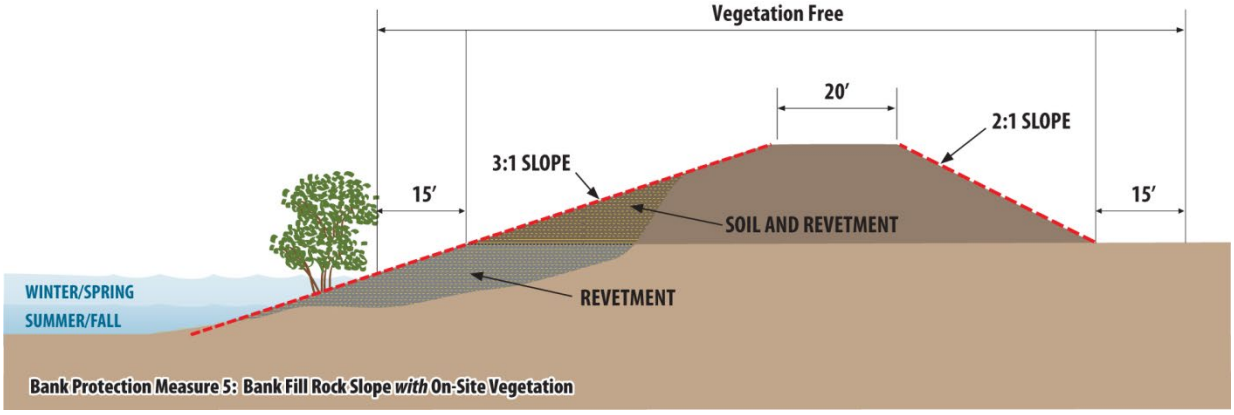


Figure 10. Measure 5 – Bank Fill Stone Protection with On-Site Vegetation

2.3.6 MITIGATION FOR ENVIRONMENTAL EFFECTS

In conjunction with the PACR, the EIS/EIR uses the PSI to identify potential programmatic environmental effects of the PBPP based on an approach that facilitates potential future work outside the current justified sub-basins. While the EIS/EIR evaluates 106 representative erosion sites, other erosion sites may be identified in the future during periodic erosion inventories for the project. Sub-basins that have not been evaluated for this PACR because there were no erosion sites identified in those sub-basins during previous inventories could be evaluated in the future if erosion sites should arise in those sub-basins. Also, sub-basins that are not currently economically-justified could be determined to be justified based on updated benefit assessments as documented in an Economic Reevaluation Report (ERR).

Design and implementation of the measures discussed above will be addressed on a case by case basis and will be designed in an environmentally-sustainable way in accordance with USACE's Environmental Operating Principles. Implementing on-site native re-vegetation will reduce adverse construction impacts, create a sustainable environment, and reduce the need for compensatory mitigation. In those instances where such on-site design efforts are insufficient and a significant habitat impact occurs, additional off-site mitigation features will be added to the plans to the extent necessary to comply with requirements of the project's Biological Opinions, pursuant to the Endangered Species Act (ESA).

SECTION 3 — AUTHORIZATION

The SRFCP was authorized by the Flood Control Act of 1917, Pub. L. 64-367, § 2, 39 Stat. 948, 949 (1917) and has been modified and extended several times by subsequent authorizations. A Chief of Engineers Report dated 9 May 1960 (Senate Doc. 86-103) recommended a program of remedial bank protection work as a modification of the SRFCP. The initial portion (Phase I) of the SRBPP was authorized by Congress in the Flood Control Act of 1960, Pub. L. 86-645, § 203, 74 Stat. 498 (1960). It was authorized as a long-range program for construction of bank erosion control works and setback levees to protect the SRFCP levees from failures due to erosion. Construction of the 430,000 LF in the Phase I authority was completed in 1974. Phase I also included recreation facilities.

A Chief's Report dated 21 September 1972 recommended a second phase consisting of 405,000 LF of bank protection works (H. Doc. 93-151). Phase II was authorized by the River Basin Monetary Authorization Act of 1974, Pub. L. 93-252, § 202, 88 Stat. 49. Construction began in 1975 and is nearly completed. The 1974 Phase II authority is the baseline for changes to the SRBPP as reported in this PACR.

In 1982, Congress specifically authorized extension of the SRBPP from the upstream end of the levee system to Chico Landing to include the Butte Basin reach (RM 176 left/184 right to RM 194 (Continuing Appropriations Resolution, Pub. L. 97-377 § 140, 96 Stat. 1916 (1982)).

A Chief's Report dated 1 September 1981 recommended a fish and wildlife program to provide habitat mitigation for Phase I of SRBPP. The 1981 Chief's Report was supplemented and modified by a Chief's Report dated 2 June 1983 to exclude mitigation for removal of vegetation that is deferred maintenance of SRFCP levees and, therefore, a non-federal responsibility. The project for mitigation of fish and wildlife losses was authorized at a total cost of $1,410,000 by the Water Resources Development Act of 1986, Pub. L. 99-662, § 601, 100 Stat. 4140. The authorized mitigation for Phase I is complete.

The authority for Phase II was modified by Congress by WRDA 2007, which modified the existing SRBPP to authorize bank erosion and setback levee work as follows:

> "SEC. 3031. Section 202 of the River Monetary Authorization Act of 1974 (88 Stat. 49) is amended by striking "and the monetary authorization" and all that follows through the period at the end and inserting; "except that the lineal feet in the second phase shall be increased from 405,000 lineal feet to 485,000 lineal feet." Table 1 below summarizes the different authorities of the SRBPP.

Table 1. History of Sacramento River Bank Protection Project

Project Phase	Authorizing Act, Year, Public Law	Authorized Length of Improvements (Linear Feet)	Number of Bank Protection Sites[1]	Status
Phase I	Flood Control Act of 1960, Pub. L. 86-645, § 203, 74 Stat. 498	430,000	412	Complete
Phase II	River Basin Monetary Authorization Act of 1974, Pub. L. 93-252, § 202, 88 Stat. 49	405,000	420+	In-progress
Amendment to Phase II	Water Resources Development Act of 2007, Pub. L. 110-114, § 3031, 121 Stat. 1113	80,000	106[2]	Work is dependent upon approval of this PACR and signing of a PPA

1. The number of bank protection sites within the authorized footprint.
2. Priority site inventory (15 erosion sites in current JPSI).

SECTION 4 — FUNDING SINCE AUTHORIZATION

Table 2 shows the history of Federal funding for SRBPP Phase II since authorization in the River Basin Monetary Authorization Act of 1974. In Fiscal Year 2019, the remainder of the estimated federal cost was allocated to the Sacramento District to complete construction and fiscally close out the portion of the project that is covered by the existing Local Cooperation Agreement, which is for 405,000 LF of Phase II.

Table 2. SRBPP Phase II Federal Funding for Construction Post-Authorization

Fiscal Years	Funding ($1,000)		Fiscal Years	Funding ($1,000)
1975	1,000		1998	4,315
1976	3,802		1999	5,400
1977	2,850		2000	2,803
1978	2,225		2001	3,929
1979	1,450		2002	3,546
1980	1,710		2003	1,837
1981	3,200		2004	1,065
1982	2,700		2005	3,979
1983	679		2006	29,208
1984	2,500		2007	21,000
1985	3,500		2008	14,932
1986	3,462		2009	22,967
1987	6,727		2010	14,171
1988	9,131		2011 1	8,878
1989	4,450		2012 1	9,797
1990	3,550		2013 1	2,905
1991	1,101		2014	3,000
1992	1,251		2015	2,500
1993	2,201		2016	6,000
1994	2,654		2017	8,000
1995	3,900		2018	150
1996	3,251		2019	19,265
1997	4,870		Total	261,811

1. Allocation amounts are net of rescissions and reprogramming.

SECTION 5 — CHANGES IN SCOPE OF AUTHORIZED PROJECT

The WRDA of 2007 authorized a change in project size consisting of an additional 80,000 LF of levee repairs under Phase II. There is no change in project purpose or geographical extent. The additional 80,000 LF will be constructed within the same project area as the original authority. This PACR documents and evaluates the authorized increase in the Phase II project size as a post-authorization change, per Engineer Regulation 1105-2-100, Appendix G, and as directed by the Implementation Guidance for Section 3031 of the WRDA of 2007.

SECTION 6 — CHANGES IN PROJECT PURPOSE

There are no changes in the project purpose of the SRBPP, which continues to be flood risk management (with some completed recreation features). The 1972 Chief's Report (House Doc. 93-151) states bank protection is beneficial to navigation, recreation and fish and wildlife. Benefits from these other purposes are considered incidental and were not quantified.

SECTION 7 — CHANGES IN LOCAL COOPERATION REQUIREMENTS

Construction of Phase II initially adopted the requirements in the 1962 Local Cooperation Agreement (LCA) for the original Phase I work. A new LCA signed on April 20, 1984 contained updated local cooperation requirements and specified cost sharing at two-thirds Federal – one-third non-federal. In response to the 1986 WRDA, two LCAs dated August 15, 1988 and December 7, 1988 revised non-federal cost sharing to 75-25 percent for a total of 141,415 LF of bank protection. At the end of 2006, when work specific to the two LCAs executed in 1988 was completed, the cost share and local cooperation requirements reverted back to the 1984 LCA, and the cost share changed to two-thirds Federal and one-third non-federal.

The current local cooperation requirements for the SRBPP are included in the LCA that was signed in 1984. The standard requirements have changed since 1984. Changes to local cooperation requirements, which are summarized in Section 14 and in Table 3 below, will be applied to a new PPA consistent with the current approved model agreement.

Table 3 below compares the 1984 local cooperation requirements to the current standard local cooperation requirements.

Table 3. Comparison of 1984 Local Cooperation Requirements to Current Standard

Item	1984 Local Cooperation Agreement	Current Requirements or Allowable Provisions
Real Estate	Provide, without cost to the Government, all real estate interests necessary for the Project.	(Same as in 1984 LCA.)
Damages Due to Construction, O&M of Project	Hold and save the Government free from damages due to the construction, O&M of the Project, except damages due to the fault or negligence of the Government or its Contactors.	(Same as in 1984 LCA.)
Operation and Maintenance	Operate and maintain the Project, or integral parts thereof, in accordance with regulations prescribed by the Secretary of the Army.	(Same as in 1984 LCA.)
Relocations	Undertake all relocations and alterations of roads, bridges (except railroad bridges), buildings, irrigation facilities, and other utilities which are necessary for the construction and operation of the Project.	(Same as in 1984 LCA.)
Civil Rights Act of 1964	Comply with Section 601 of Title VI of the Civil Rights Act of 1964 (Public Law 88-352) that no person shall be excluded from participation in, denied the benefit of, or be subjected to discrimination in connection with the Project on the grounds of race, creed, or national origin.	(Same as in 1984 LCA.)
Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646)	Assure that, in conjunction with acquiring rights-of-way, affected persons will be adequately informed of the benefits, policies, and procedures described in the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 and in accordance with Sections 210 and 305 of said Act and implementing regulations.	(Same as in 1984 LCA.)

Item	1984 Local Cooperation Agreement	Current Requirements or Allowable Provisions
Section 221 of Public Law 91-611	Assume responsibility and pay damages, if necessary, in the event there is a failure to perform in accordance with the terms of this agreement and any other applicable provisions of Section 221 of Public Law 91-611.	(Same as in 1984 LCA.)
Cost Sharing	Contribute an amount in cash which, when added to the cost of lands, easements, rights-of-way and utility changes, equals one-third of the cost of each unit of the remedial work, this contribution to be based on the cost of the improvements shown by estimates approved by the Chief of Engineers to have economic superiority over possible alternative measures.	Change: Non-federal sponsor cost share is now 35%, including credit for real estate interests and relocations. Possible Change: Current model project partnership agreements (PPA) allow Work-in-Kind (WIK) more generally for legitimate cost-shared project costs
Bank Stabilization versus Setback Levees	For reaches where local interests prefer bank stabilization to the setbacks recommended by the Chief of Engineers, contribute the costs over and above the costs of setbacks, and provide the local contribution as indicated above.	(Same as in 1984 LCA.)

SECTION 8 — CHANGES IN LOCATION OF PROJECT

There are no changes to the project location as a result of the additional 80,000 LF.

SECTION 9 — DESIGN CHANGES

There are two major sources of design changes for the Phase II 80,000 LF: sea level rise and vegetation management. There could be future changes to flow, possibly higher flows, due to climate change. Due to uncertainty in the science, revised flows due to climate change are not quantified or reflected in the hydrology. Future condition hydrology for this project is equal to existing condition hydrology. Thus, there are no changes in design in response to a new future condition hydrology.

9.1 RELATIVE SEA LEVEL RISE

ER 1100-2-8162 "Incorporating Sea Level Change Considerations in Civil Works Programs, issued December 2013, provides guidance for "…incorporating the direct and indirect physical effects of projected future sea level change across the project life cycle in managing, planning, engineering, designing, constructing, operating, and maintaining USACE projects and systems of projects." The ER requires every USACE coastal activity within the extent of the estimated tidal influence to consider potential relative sea-level change effects.

As a result of anticipated future sea level rise, setback levee design criteria may need to be updated to incorporate robust design features in anticipation of increased mean water surface elevations.

Relative sea level rise (RSLR) includes the motion of the land in relation to the water as well as increase in the water surface level. Appendix A5, Section 4.0 (Hydraulic Engineering) discusses in more detail the programmatic assumptions related to RSLR that were used for this PACR and will be used for future SRBPP assessments.

9.2 VEGETATION MANAGEMENT

The current USACE VMP, through the draft PGL on Process for Requesting a Variance From Vegetation Standards for Levees and Floodwalls (February 17, 2012), Implementation Guidance for Section 3013 of WRRDA 2014, and EP 1110-2-18 severely restricts vegetation on levees. Bank protection measures incorporate vegetation to avoid or minimize adverse impacts on significant fish and wildlife habitat. The following are descriptions of how the USACE VMP is interpreted for development of the programmatic plan for the 80,000 LF.

The Sacramento District is managing vegetation within the construction footprint on USACE construction projects as follows:

- Where practicable, trees will be avoided by minimizing the construction footprint.
- Trees will be removed when necessary to construct levee features.
- Trees remaining within the construction footprint and which are within the vegetation free zone will require a vegetation variance.
- Trees on the levee crest, landside slope, and landside toe may be pruned, limbed, or removed to promote safe and effective levee patrolling and flood fighting.

The draft PGL on Process for Requesting a Variance from Vegetation Standards for Levees and Floodwalls provides guidance for preparation, review, and approval of variances from the vegetation policy described in EP 1110-2-18 and does the following:

- Provides an outline for a vegetation variance request report.
- Describes a procedure to analyze a tree fall failure mode.
- Stipulates the process and schedule for review and approval of vegetation variances.

Implementation Guidance for WRRDA 2014, Section 3013 provides guidance for updating vegetation management policy and for managing vegetation management in the interim while policy is being updated. This Implementation Guidance does the following:

- Lays out the process for reviewing and revising vegetation management policy.
- Provides interim vegetation management guidance.
- Stipulates evaluation of alternatives for studies, design, and construction; will consider life safety, economics, and the environment.

This vegetation management guidance restricts the planting of on-site vegetation, which may lead to increased off-site mitigation and/or the use of setback (including adjacent) levees to avoid the removal of vegetation that cannot be mitigated on-site.

SECTION 10 — CHANGES IN TOTAL PROJECT FIRST COSTS

This PACR provides an estimate of the first cost for the 80,000 LF. This cost estimate is extrapolated from the average cost per LF for the 7,204 LF that are included in the certified cost estimate for the JPSI. The extrapolated estimate of first costs is $567 million, at October 2018 price levels. The cost estimate for 80,000 LF is included in this PACR so that changes in total project first costs can be reported. The cost estimate for 80,000 LF is also necessary to support an approximation of the Federal and non-federal cost share responsibilities in a new PPA.

Table 4 shows available information on changes to project first costs. An authorized project cost is not identified because the limit of the SRBPP Phase II authority is expressed in terms of lineal feet, not costs.

Table 4. SRBPP Phase II Changes to Total Project First Costs ($1,000)

Portion of Phase II	Estimated Cost of Recommended Project	Authorized Project Cost[3]	Authorized Project Cost Updated to Current Price Level[3]	Project Cost Last Presented to Congress
405,000 LF	$358,884[1]	N/A	N/A	348,904[4]
80,000 LF	$566,874[2]	N/A	N/A	N/A
Total Phase II	$925,758	N/A	N/A	N/A

1. Total Federal funding provided for completion and required non-federal cost-share.
2. October 2018 price level.
3. The current project authorization is expressed in terms of lineal feet of bank protection, not costs.
4. Total first cost for 405,000 LF based on total project cost summary (TPCS) dated May 2, 2016 (Oct 2015 price level). (The May 2, 2016 TPCS provided the basis for the estimated fully funded project cost presented to Congress in the President's Budget for FY2018.)

Costs for the 15 erosion sites in the JPSI were certified on March 19, 2019 to support this programmatic document. The Economic Reevaluation Reports and Design Documentation Reports prepared during the future site selection and implementation process will be supported by certified cost estimates for all proposed erosion repair sites.

SECTION 11 — CHANGES IN PROJECT BENEFITS

The 1972 Chief's Report (H. Doc. No. 93-151) for Phase II does not provide benefit information for the first 405,000 LF of Phase II bank protection. The report cites the 1960 findings of the Board of Engineers for Rivers and Harbors regarding justification. The Board's findings were:

> "The Board considers it impractical to assign a monetary value to the benefits which would result from the removal of threats of eventual levee breaks when there are hundreds of vulnerable locations in various states of deterioration."

While benefits were not calculated for the originally-authorized Phase II work, benefits have been estimated for the additional 80,000 LF authorized by WRDA 2007. This is consistent with the Implementation Guidance for Section 3031 of WRDA 2007, which states that the increase in project size (i.e., additional 80,000 LF) should be evaluated and documented as a post-authorization change and the required documentation should be prepared per ER 1105-2-100, Appendix G, paragraph G-16.

An economic analysis for the additional 80,000 LF was completed for this PACR and is described in Appendix D. Estimates of benefits and benefit-to-cost ratios were computed for individual economic sub-basins (impact areas), which are discrete areas protected by a SRFCP levee or set of SRFCP levees. These sub-basins all fall within the SRFCP footprint as shown in Figure 11, and were originally developed for the 2002 Sacramento and San Joaquin Basins Comprehensive Study. While there are a total of fifty sub-basins in the study area, only twenty-four sub-basins were evaluated for this PACR since these were the ones that contained erosion sites at the time of the analysis. Table 5 lists the economic sub-basins that were evaluated for this PACR. Table 6 lists the 15 representative sites in the seven EJBs that are included in the JPSI. (The PSI and JPSI were based on the 2007 erosion site inventory, which has subsequently continued to change. Six of the sites in the JPSI are not listed in the most recent (2017) site inventory, which indicates that they have been repaired through the SRBPP or other means. Nonetheless, the JPSI is representative of the future erosion repair sites in the EJBs.)

The economic analysis used existing data as much as possible due to resource constraints. In doing so, non-standard techniques (e.g., adjustment of with-project levee fragility curves to generate without-project levee fragility curves) were utilized in order to estimate benefits. While some of the techniques used to estimate benefits may be considered non-standard, it is important to note that the sub-basins being recommended (i.e., those that are economically justified with benefit-to-cost ratios greater than unity) in this PACR are primarily those that are highly urbanized and where the potential for catastrophic consequences in terms of life loss and property damage are significant.

An Economic Reevaluation Report (ERR) using additional site-specific data (e.g., geotechnical levee fragility curves) will be developed using standard USACE methods prior to completion of each draft DDR for implementation of the additional 80,000 LF. These ERRs will be used to (1) verify that the sub-basins which were determined in this PACR to be economically justified are still justified, (2) estimate benefits for sub-basins not evaluated for this PACR due to insufficient data or lack of existing erosion sites and/or (3) re-estimate benefits for sub-basins already evaluated for this PACR where changed conditions warrant or for which more current data has become available. It is expected that additional sub-basins will be economically justified in the future.

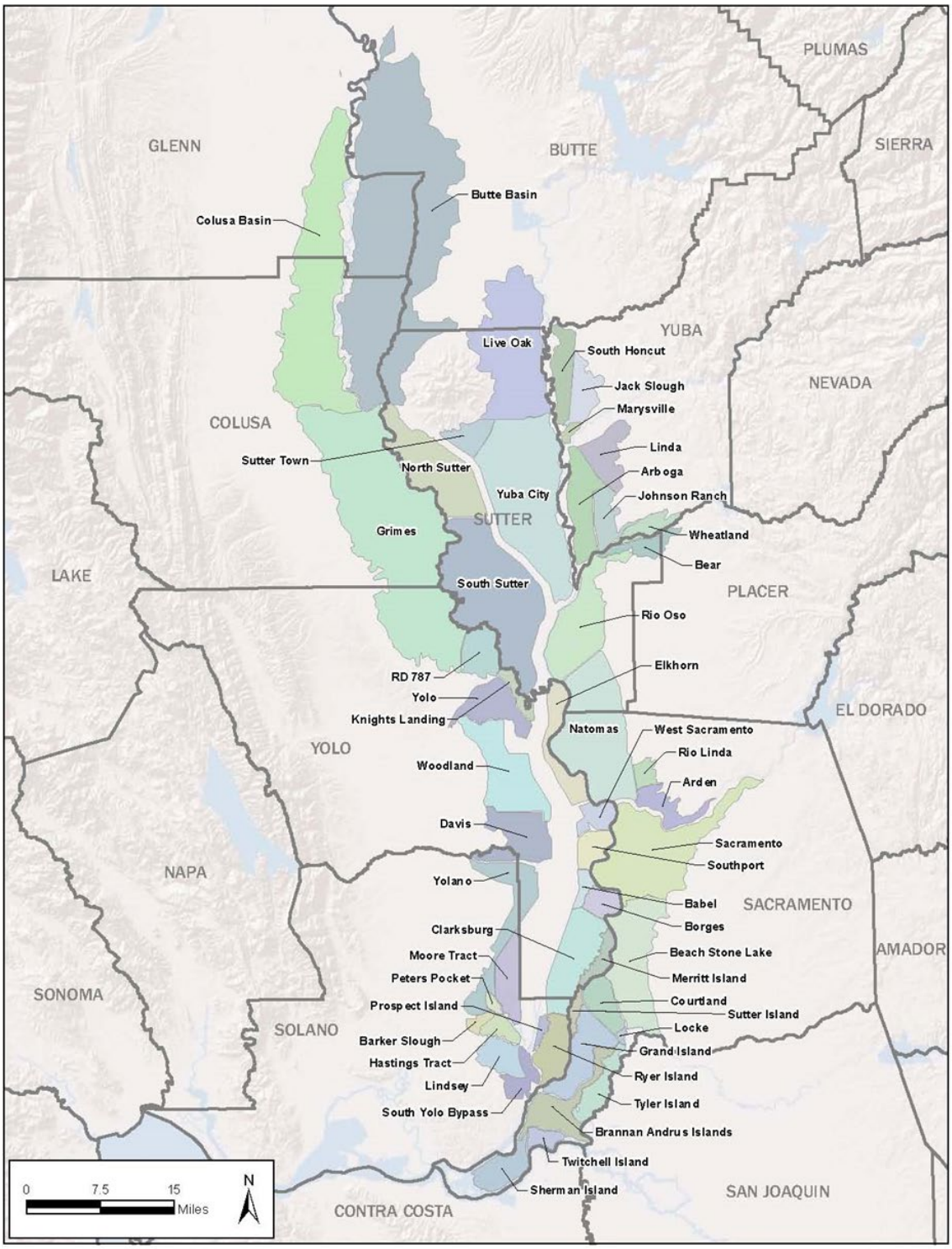


Figure 11. Economic Sub-Basins (Impact Areas)

Table 5. Economic Sub-Basins (Impact Areas) Evaluated for PACR

Economic Sub-Basin with Erosion Sites	Economically Justified: Yes/No
Butte Basin	Yes
Grimes	No
South Sutter	No
Knights Landing	No
Yolo	Yes
Woodland	No
Davis	No
Linda	No
Rio Oso	Yes
North Sutter	No
Elkhorn	No
Natomas	Yes
Arden/Rio Linda	No
West Sacramento	Yes
Southport	Yes
Sacramento	Yes
Clarksburg	No
Merritt Island	No
Sutter Island	No
Grand Island	No
Tyler Island	No
Brannan Andrus	No
Ryer Island	No
Hastings Tract	No

Table 6. Representative Erosion Sites in Economically Justified Sub-Basins

Impact Area	Erosion Site (Waterway/River Mile/L or R Bank)	Linear Feet
Butte Basin	Sacramento River 152.8 L	198
	Sacramento River 163.0 L	1213
	Sacramento River 168.3 L	546
	Sacramento River 172.0 L	525
Yolo	Cache Creek 3.9 L	480
	Knights Landing Ridge Cut 0.2 R	768
Rio Oso	Bear River 0.8 L	233
	Feather River 0.6 L	288
	Feather River 5.0 L	910
Natomas	Sacramento River 78.3 L	657
West Sacramento	Sacramento River 62.9 R	175
	Sacramento River 63.0 R	87
Southport	Sacramento River 56.5 R	373
	Sacramento River 56.7 R	665
Sacramento	Sacramento River 56.6 L	86
Total for 15 Sites		7204

11.1 INCIDENTAL BENEFITS

- Bank protection will result in incidental benefits in addition to flood risk management. The SRBPP Phase II 80,000 LF results in potential incidental benefits to ecosystem restoration, water supply, navigation, and recreation. This evaluation does not quantify these benefits; however, some examples of the different benefits are provided below.

- Ecosystem restoration benefit example:
  - Increase in floodplain for riparian vegetation and wetlands due to construction of setback levees. The setback levees included in the preliminary designs within the PSI provide lands for environmental mitigation only. Setback levees actually constructed could provide lands that will present ecosystem restoration opportunities.

- Water supply benefit examples:
  - Improvement to water quality by avoidance of pesticide contamination from flooding agricultural areas
  - Reduction in risk of salt water intrusion in the Delta through avoidance of levee failure due to erosion.
- Navigation benefit examples:
  - Reduction in obstacles to boat traffic in the Sacramento River due to reduction in bank erosion.
  - Reduction in sediment load and O&M dredging of the channel and harbors.
- Recreational benefit examples:
  - Reduction in damages to boating facilities due to erosion protection measures.
  - Reduction in damages to hiking trails due to erosion protection measures.

SECTION 12 — BENEFIT TO COST RATIO

Benefit-to-cost ratios (BCRs) were not developed for the original Phase II SRBPP, as described in Section 2.0. The net benefit and BCR analyses for the seven sub-basins (impact areas) that were determined to be economically justified are listed in Table 7. The BCR results were based on available hydrologic, hydraulic, geotechnical, and economic data. More detail can be found in Appendix D (Economics).

The bank repairs proposed for many of the sub-basins evaluated for this PACR are not economically justified at this time. However, as part of the PBPP, erosion sites identified in future site inventories and which are located in non-economically justified sub-basins may still undergo further economic analysis using updated or newly-developed data. These future evaluations may result in additional sub-basins becoming economically justified.

Table 7. Economically-Justified Sub-Basins ($1,000s)

Impact Area	Average Annual Benefit	Average Annual Cost[1]	Net Benefits	Benefit-to-Cost Ratio (BCR)
Butte Basin	4,402	542	3,860	8.1 to 1
Natomas	1,185	273	912	4.3 to 1
Rio Oso	406	350	57	1.2 to 1
Sacramento	19,612	132	19,480	148.2 to 1
Southport	15,662	109	15,553	143.7 to 1
West Sacramento	14,935	468	14,467	31.9 to 1
Yolo	20,790	63	20,728	331.4 to 1
TOTAL	76,993	1,936	75,056	39.8 to 1

1. Costs are at October 2018 Price Levels, 2.875 percent discount rate, 50-year period of analysis, in $1,000s

The USACE Sacramento District will prepare Economic Reevaluation Reports (ERRs) that will be approved by the South Pacific Division (SPD). Standard risk analysis procedures will be used in future SRBPP Economic Updates, with a focus on revised or newly-developed geotechnical levee fragility curves.

A few of the economic sub-basins in the SRBPP overlap with those areas being assessed under the Natomas, American River Common Features (ARCF-WRDA 2016), and West Sacramento studies. Benefits estimated for this PACR only include those associated with repairing erosion sites, and do not include benefits associated with addressing other failure mechanisms such as levee stability, underseepage, and/or through seepage like in these other studies. While erosion repairs are proposed in the authorized plans for the Natomas, ARCF (WRDA 2016), and West Sacramento studies, they were not the primary risk driver and did not drive plan selection or economic feasibility. The SRBPP assessment assumed that erosion improvements proposed for these other studies were not yet in place.

SECTION 13 — CHANGES IN COST ALLOCATION

There are no changes to cost allocation. All costs are allocated to flood risk management.

SECTION 14 — CHANGES IN COST APPORTIONMENT

Some of the Phase II 405,000 LF was cost shared according to the original authorization that required a non-federal share of one-third of the total costs. See Flood Control Act of 1960, Pub. L. 86-645, § 203, 74 Stat. 498 (1960). This was specified in the Phase II LCA of April 20, 1984. The cost sharing of the Phase II 80,000 LF will be in accordance with WRDA 1986, as amended, which specifies that cost apportionment generally will be 65% Federal and 35% non-federal. The following is quoted from WRDA 1986:

"(a) Flood control

(1) General rule

The non-federal interests for a project with costs assigned to flood control (other than a nonstructural project) shall –

(A) pay 5 percent of the cost of the project assigned to flood control during construction of the project;

(B) provide all lands, easements, rights-of-way, and dredged material disposal areas required only for flood control and perform all related necessary relocations; and

(C) provide that portion of the joint costs of lands, easements, rights-of-way, dredged material disposal areas, and relocations which is assigned to flood control.

(2) 35 percent minimum contribution

If the value of the contributions required under paragraph (1) of this subsection is less than 35 percent of the cost of the project assigned to flood control, the non-federal interest shall pay during construction of the project such additional amounts as are necessary so that the total contribution of the non-federal interests under this subsection is equal to 35 percent of the cost of the project assigned to flood control.

(3) 50 percent maximum

The non-federal share under paragraph (1) shall not exceed 50 percent of the cost of the project assigned to flood control. The preceding sentence does not modify the requirement of paragraph (1)(A) of this subsection.

(4) Deferred payment of amount exceeding 30 percent

If the total amount of the contribution required under paragraph (1) of this subsection exceeds 30 percent of the cost of the project assigned to flood control, the non-federal interests may pay the amount of the excess to the Secretary over a 15-year period (or such shorter period as may be agreed to by the Secretary and the non-federal interests) beginning on the date construction of the project or separable element is completed, at an interest rate determined pursuant to section 2216 of this title. The preceding sentence does not modify the requirement of paragraph (1)(A) of this subsection. 33 U.S.C. § 2213."

For the Phase II 80,000 LF, the cost share will be in accordance with WRDA 1986, codified at 33 U.S.C. § 2213 (quoted above), and current USACE policy. Table 8 provides a summary of estimated first cost of the 80,000 LF. The programmatic cost estimate for 80,000 LF was extrapolated from the certified cost estimate of $51,048,000 for the 15 representative sites in the JPSI (see Subappendix A2), which has a total of 7,204 LF of erosion repair sites, based on the average cost per linear foot. In Table 8, each account was pro-rated based on the certified cost estimate for the representative sites. Of the extrapolated total project cost of approximately $566,874,000 for the Phase II 80,000 LF, $368,468,000 is the Federal share, and $198,406,000 is the non-federal share. The cost is based on the JPSI, and is only an approximation of future actual costs. As the 80,000 LF is implemented, detailed costs of bank protection at selected erosion sites will be developed. Table 9 provides data related to apportionment of the estimated first costs.

Table 8. Estimated Programmatic First Cost for 80,000 LF of Erosion Repairs

Cost Estimate Account	Amount [1]
01 Lands and Damages	$76,002
02 Relocations	$4,586
06 Fish and Wildlife Facilities	59,522
11 Levees and Channels	35,369
16 Bank Stabilization	252,549
30 Planning, Engineering, and Design (PED)	86,896
31 Construction Management (CM)	51,949
Total First Cost	566,874

1. Costs are at October 2018 price level; in $1,000s.
2. Cultural Resources costs are included in PED cost. No cultural resources data recovery costs are included because specific repair sites have not been determined.

Table 9. Apportionment of Estimated First Cost

Cost Component	Federal	Non-Federal	Total [1]
Lands, Damages, and Relocations	$0	$80,589	$80,589
Construction, PED, and CM	400,285	86,000	486,285
Subtotal	400,285	166,589	566,874
5 Percent Cash Contribution	-28,344	28,344	
Subtotal	371,942	194,932	566,874
Additional Cash Contribution	-3,474	3,474	
Total Contributions	368,468	198,406	566,874
Contribution Percent	65%	35%	100%

1. Costs are at October 2018 price level; in $1,000s.

SECTION 15 — ENVIRONMENTAL CONSIDERATIONS IN CHANGES TO RECOMMENDED DESIGN CRITERIA

Environmental considerations are addressed in detail in the final EIS/EIR that accompanies this PACR in separate volumes. Important considerations regarding vegetation management, fish and wildlife habitat, endangered species, and cultural resources are highlighted in this section.

The current USACE VMP policy, including vegetation management EP 1110-2-18, "provides guidelines to assure that landscape planting and vegetation management provide aesthetic and environmental benefits without compromising the reliability of levees, flood walls, embankment dams, and appurtenant structures. It is important to note that all minimum guidelines presented herein are just that - minimums. The dimensions of the vegetation-free and root-free zones defined in this document provide the minimum acceptable buffer between vegetation and flood damage reduction structures. For each individual project, the design team must consider whether these minimum buffers are adequate to the specific needs and conditions of the project." In some instances, a variance is appropriate and can be requested.

The PBPP for Phase II 80,000 LF integrated fish habitat and vegetation cover considerations along with engineering considerations. Where in-place bank protection resulted in unavoidable losses to vegetation and fish habitat, setback levees and adjacent levees were specified as the appropriate measures. Off-site mitigation would be provided to offset lost vegetation that cannot be replaced on-site.

Actual impacts and mitigation necessary will be developed and reported in site-specific tiered environmental documents once individual erosion sites are selected and site-specific bank protection measures are designed, including preparation of site specific biological assessments to be provided to resource agencies during formal consultation under Section 7 of the Endangered Species Act and the Magnuson-Stevens Act, supplemental NEPA documentation, as appropriate, and Section 401 Clean Water Act certification. This will be done during the implementation phase.

15.1 ENVIRONMENTAL ISSUES

The estimated total project costs in the Chief's Report cited in the 1974 authorization of Phase II included measures to preserve and mitigate habitat resources, which were estimated as 10 percent of construction costs. During the initial implementation of Phase II, resource agencies annually reviewed plans for construction and recommended measures to avoid or compensate for adverse impacts. The two primary mitigation measures were purchase of environmental easements at work sites and build out of eroding banks using rock fill to preserve vegetation growing on banks.

In the mid-1980s, impact analysis and mitigation planning became more quantitative with the advent of habitat modeling. In addition, the United States Fish and Wildlife Service (USFWS) opposed any loss of woody riparian vegetation, which resulted in a more comprehensive mitigation effort.

In 2000, the USFWS and National Marine Fisheries Service (NMFS) issued a draft jeopardy biological opinion (BO) under the Endangered Species Act (ESA) for the SRBPP. The draft jeopardy BO was prompted by the potential effects of imminent erosion protection construction that was found to likely jeopardize several fish and wildlife species by destroying habitat. A non-jeopardy opinion was issued in 2001 after the USACE agreed to incorporate a Reasonable and Prudent Alternative into the existing project description, which contained several additional conservation measures. Only limited work proceeded over the next several years. A programmatic BO was issued in 2008 for the remainder of the Phase II 405,000 LF.

There has been on-going coordination with USFWS and NMFS throughout this programmatic planning process. The Final Coordination Act Report has been received, and Endangered Species Act (ESA) Section 7 programmatic consultations with USFWS and NMFS have been completed, resulting in non-jeopardy Biological Opinions. Due to the dynamic erosional forces within the Sacramento River watershed, there is a high degree of uncertainty regarding the number of erosion sites, the sites that may be determined to be critical, and the linear footage of sites. This uncertainty and the potential for impact to the numerous protected species within the SRBPP have led to an incremental approach in ESA Section 7 and Magnuson-Stevens Act consultation with resource agencies. The initial ESA Section 7 and Magnuson-Stevens Act programmatic consultation for the additional 80,000 LF was limited to 30,000 LF within the seven current economically justified basins. Initial erosion repairs will likely occur in those basins. As described in the Site Selection and Implementation Process (Appendix B), site-specific consultations will be conducted for each cohort of proposed erosion repairs. Subsequent programmatic consultation(s) will occur when the length of repairs approaches 30,000 LF and/or when updated economic analyses identify additional economically justified basins with eligible erosion repair sites.

15.2 CULTURAL RESOURCES PROGRAMMATIC AGREEMENT

The cultural programmatic agreement (PA) between the USACE, CVFPB and the State Historic Preservation Office (SHPO) was developed as the process by which Section 106 of the National Historic Preservation Act (NHPA) would be fulfilled. Due to the nature of the project, the PA was developed to streamline the process by which the USACE would identify, evaluate and consult with the SHPO and any concurring parties, including federally recognized American Indian/Native Alaskan Tribes, concerning any historic properties that may be impacted by the project. The cultural resources PA is applicable to the 80,000 LF.

SECTION 16 — PUBLIC INVOLVEMENT

In connection with the EIS/EIR and this PACR, a number of public involvement meetings were held. These are described below.

16.1 SCOPING MEETINGS

A Notice of Preparation (NOP) of an EIR and a Notice of Intent (NOI) to prepare an EIS were issued informing agencies and the general public that an EIS/EIR was being prepared. These notices were published in the January 30, 2009 issue of the Federal Register on pages 5649 to 5650. To allow for public involvement, a series of four scoping meetings were held in the cities of Colusa, Chico, Sacramento, and Walnut Grove in February 2009.

The meetings were held with the goal of introducing the public to the proposed project and requesting that they provide input regarding preparation of the EIS/EIR for Phase II work and its compliance with environmental requirements such as NEPA and CEQA. The scoping meetings were held in an open house format and concluded with a period for comments.

A total of 15 written comments were received. Other verbal comments were noted in transcripts. The comments are included in the EIS/EIR. Comments received related to vegetation on levees, flood control issues and related programs, coordination with agencies, and public involvement. Comments were received from NMFS, California Department of Transportation, The Nature Conservancy, the Delta Protection Commission, California State Lands Commission, Sacramento Regional County Sanitation District and the Audubon Society. Comments were also received from Reclamation District (RD) 1001, Butte County Public Works, California State Parks, the City of West Sacramento, as well as local individuals.

16.2 AGENCY INVOLVEMENT

16.2.1 INTER-AGENCY WORKING GROUP

The Inter-Agency Working Group (IWG) was established in the fall of 2001 to support the work of the SRBPP. The IWG's primary goals are to identify, evaluate, design, and endorse conservation measures that are consistent with the BOs and the USACE mandate to provide flood protection. Actions taken by the SRBPP must fully compensate for effects to endangered species. The IWG includes representatives from the USACE, CVFPB, USFWS, NMFS, California Department of Water Resources (DWR), and California Department of Fish and Wildlife (CDFW). The IWG evaluates the potential use of setback levees, large woody materials, rock removal, flood easements/land acquisition and inter-levee land restoration efforts. The IWG may also consider other measures that restore fluvial function and address the requirements of BOs. As prescribed in the August 23, 2001 BO regarding the IWG, "*the IWG shall consider the economic, endangered species, engineering, environmental, public safety, and real estate issues when recommending potential solutions*" related to each repair. IWG meetings are held monthly, are facilitated, and are meant to coordinate activities of the SRBPP with State and Federal resource agencies. This group's purview includes all phases of the SRBPP since issuance of the August 23, 2001 BO. The BO recommends the IWG continue during implementation of the 80,000 LF.

16.2.2 CONFERENCES SPONSORED BY THE SRBPP TEAM

The Sacramento River Watershed Symposium was held in August 2009. The symposium was held to educate the public on different projects and programs in the Sacramento River Watershed. Topics discussed included the SRBPP Phase II and the potential future Phase III, the Central Valley Integrated Flood Management Study and the West Sacramento Project General Reevaluation Report. Also discussed was the NMFS perspective on species protection and recovery and the SRBPP

The USACE Engineer Research and Development Center (ERDC) and the USACE Institute for Water Resources held a conference in February 2010. The purpose was to review current work and studies being performed, and identify other technical studies to be developed to implement the SRBPP. The goal of the conference was to gather information that could be used to develop a five year plan of study to prioritize technical studies in determining the effects of past projects and developing future with- and without-projects. The conference succeeded in identifying several needed studies.

16.3 NATIVE AMERICAN OUTREACH

A Native American outreach and consultation process was established to identify Native American groups or individuals that may have interests or concerns about sensitive project sites, areas or archaeological investigations associated with implementation of the SRBPP. The process helps assure compliance with state and Federal cultural resource protection laws.

The process developed a list of tribes and other Native American organizations and individuals who have documented their interest in cultural resources management within California. Meetings were held to provide project information and organize a consultation process during SRBPP implementation.

Additional consultation and outreach to Native American tribes has occurred in conjunction with the development and execution of the PA and with the development and revision of the Historic Properties Treatment Plan (HPTP). More information regarding Native American outreach can be found in the companion EIS/EIR to this PACR.

16.4 PUBLIC REVIEW AND COMMENT

As part of the NEPA/CEQA process, the Draft EIS/EIR was available for public comment. The Draft EIS/EIR was circulated for public review from December 24, 2014 to February 27, 2015. A total of 18 comment letters were received from 11 Federal, State and local agencies, 3 tribes, 3 non-government organizations, and one business. Comments and responses to the comments are presented in Volume II of the Final EIS/EIR. Changes made to the content of the EIS/EIR in response to comments are shown in the Final EIR/EIS. The revisions did not result in substantive changes to either the analyses or conclusions presented in the EIS/EIR.

There is also a SRBPP Website that provided the public the opportunity to view materials and the status of the project. The description and history of the overall project, related programs, the project's environmental impacts, and status of construction activities and monitoring are included on the website. The address of the web site is:

http://www.spk.usace.army.mil/Missions/CivilWorks/SacramentoRiverBankProtection.aspx

SECTION 17 — COMPARISON OF THE RECOMMENDED PLAN TO THE SECTION 902 LIMITATIONS

Section 902, WRDA 1986, codified at 33 U.S.C. § 2280, establishes a maximum cost for most projects authorized in WRDA 1986 or subsequent Acts. The Section 902 maximum cost depends on the incorporation of a total project cost figure in the statutory authority for a project. Prior authorizations for the SRBPP pre-date WRDA 1986, and the WRDA 2007 modification did not establish an authorized cost for the total project or the Phase II 80,000 LF portion. Therefore, Section 902 does not apply to any authorized phase of the project.

SECTION 18 — HISTORY OF PROJECT

The following is a summary description of project events since the SRBPP Phase II was authorized in 1974. The events are organized as stated in the headings.

18.1 GEOGRAPHIC EXTENT

In 1982, Pub. L. 97-377 added approximately 28 river miles to the geographic extent of the SRBPP. This addition extends upstream of the SRFCP Sacramento River Levees up to Big Chico Creek, in Butte County. However, no SRBPP project levees were added in this reach.

18.2 CONSTRUCTION

Phase II repair of 405,000 LF was authorized in 1974. Construction began in 1975, and is currently on-going. Figures 12 and 13 respectively show the number of Phase II erosion sites that have been constructed by year and the linear footage that has been repaired by year. The rate of production declined dramatically following the 1980s, before picking back up at a lesser pace in 2006. Reasons for the decline are not known by current project personnel, but changes in USACE priorities, practices, and regulatory context are believed to have been contributing factors. Difficulties acquiring rights-of-way may have played a role as well. Some temporary gaps in production have been caused by challenges in consultations with resource agencies and funding limitations. Since 2013, four sites have been repaired (2015 1,548 LF, 2016 629 LF; 2017 509 LF; and 2019 997 LF).

As the SRBPP has proceeded, bank and levee erosion sites were identified and monitored through field surveys in cooperation with the State of California. Following the 1996 and 1997 large flood events that resulted in multiple levee breaches and many flood fighting efforts throughout the system, the USACE inventoried all the erosion within the system so that repairs could be directed towards the erosion sites most in need of repair. The USACE Sacramento District currently conducts field reconnaissance trips on an annual basis to identify new erosion sites and update the previously inventoried sites. This includes identification of critical erosion sites, where erosion is so severe that there is concern that a breach might occur during a large flood event.

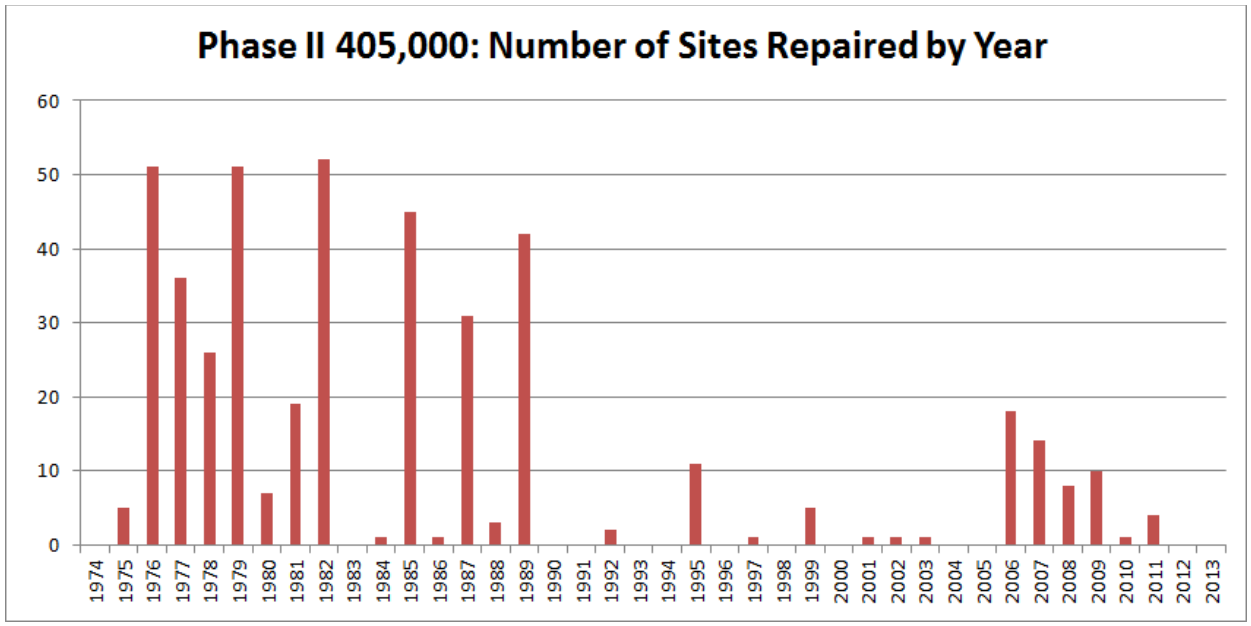


Figure 12. Number of Erosion Sites Repaired by Year

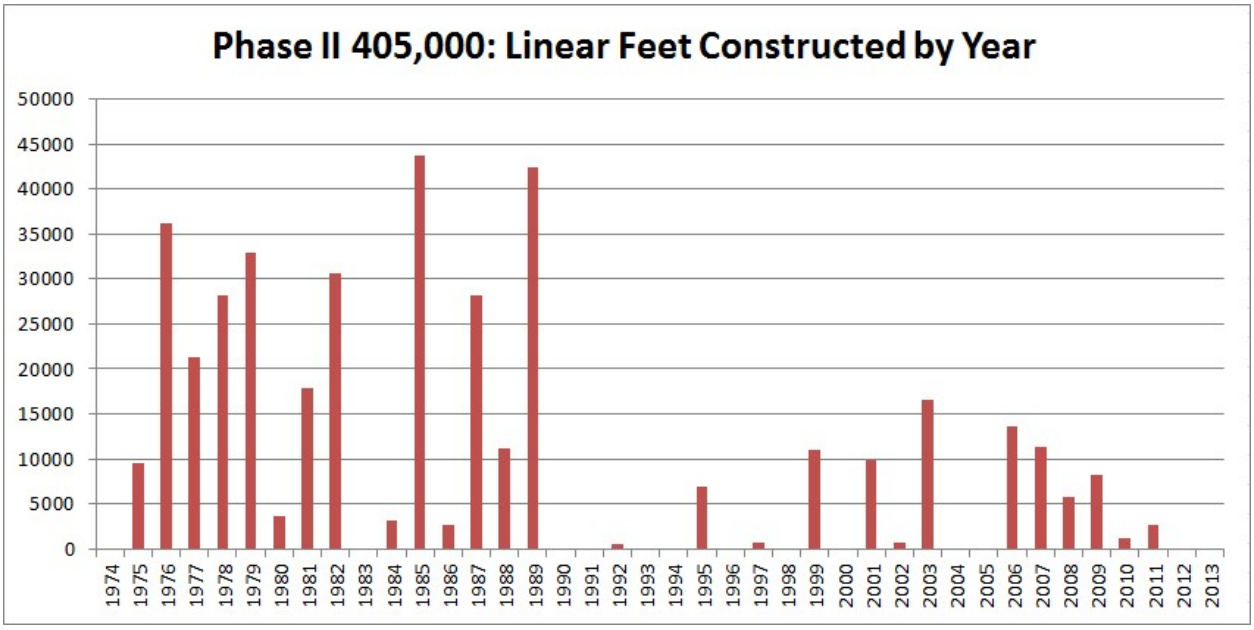


Figure 13. Linear Feet Constructed by Year

In 2004, a set of four ranking methodologies was developed as part of the annual erosion inventory to assist with prioritizing and selecting bank repair sites. These methodologies served the intended purpose, but a better procedure incorporating new guidance and addressing all disciplines was developed for the Phase II 80,000 LF and is described in Appendix B.

On February 24, 2006, following sustained heavy rainfall and runoff, Governor Arnold Schwarzenegger declared a State of Emergency for California's levee system. Following this declaration, the USACE and the California DWR repaired critical erosion sites. Repairs of both critical and non-critical erosion sites continue, but growth in the amount of erosion has outpaced repairs. The most recently published inventory, based upon 2017 field observations, reports more than 350,000 LF of erosion in the flood system at 192 sites, of which 29 are considered critical.

Recreation facilities were constructed in association with both Phases I and II. The 1972 Chief's Report for Phase II described the recreation facilities in Phase I and included $780,000 in estimated construction costs for recreation facilities in Phase II. There is no authorization language for SRBPP that specifically addresses recreation, and no specific recreation authority was cited in the 1972 Chief's Report. So, it appears that the USACE may have relied on a general recreation authority (e.g., Section 4 of the Flood Control Act of 1944 and/or the Federal Water Project Recreation Act of 1965) under policy in effect at the time.

Two recreation facilities were constructed as part of Phase II. Summaries of the recreational facilities are as follows:

1. Elkhorn Boat Facility – A recreational facility near RM 68.5 on the right bank of the Sacramento River in Yolo County was constructed to provide river access and boating docks. Also, riparian vegetation was planted.
2. River Front Park – A recreational facility near RM 28.7 on the left bank of the Feather River in Marysville was constructed to include River access, boating docks and a nature area.

18.3 **STATUS OF PHASE II 405,000 LF**

On April 20, 1984, an LCA for the SRBPP was executed between the Department of the Army (DA) and the CVFPB (then called the Reclamation Board).

On August 1988, the CVFPB and the Assistant Secretary of the Army for Civil Works (ASA-CW) signed a LCA for Separable Element 41. This agreement provided for cost sharing in accordance with WRDA 1986, which effectively reduced the State share to 25 percent.

On December 7, 1988, the Board and the ASA (CW) signed the LCA for Separable Elements 38B, 40 and 42, also in accordance with WRDA 1986.

The LCA was amended on March 26, 2006 to establish the maximum length of bank erosion repair at 405,000 LF.

On May 5, 2006, the LCA was amended to allow the state to accelerate its cash contribution, allow credit for state cash contributions and increase the total project cost estimate for the remaining authorization.

On June 20, 2006, the LCA was further amended to account for design changes and costs associated with the Flood Control Act of 1958, Pub. L. 85-500, § 215, 72 Stat. 305 (1958). This amendment concerned bank protection constructed by the State at three Cache Creek (Yolo County) critical emergency erosion sites.

As of December 2019, approximately 1,300 LF of erosion control works remain to be constructed under the original Phase II authority of 405,000 LF.

There are 41 constructed sites for which USACE has not yet issued completion notifications to the non-federal sponsor. Before completion notifications can be issued, levee safety risks posed by vegetation must be assessed and updates must be made to levee operations and maintenance manual supplements.

18.4 STATUS OF PHASE II, 80,000 LF

In 2007, the authority was modified to include another 80,000 LF. As provided in Implementation Guidance from USACE Headquarters, this PACR and supporting documents were prepared to document conformance to the USACE civil works policy.

SECTION 19 — SUMMARY OF PROGRAMMATIC BANK PROTECTION PLAN RECOMMENDATION

Following are recommendations for implementation of the additional 80,000 LF of erosion protection work authorized by Congress in WRDA 2007:

- Construct up to the authorized 80,000 LF of erosion protection features within economically justified sub-basins on erosion sites chosen based upon the Site Selection and Implementation Process for Bank Repairs (described in Appendix B). Construction would be subsequent to future site-specific DDRs, site-specific tiered environmental compliance documentation, including preparation of site specific biological assessments to be provided to resource agencies during formal consultation under Section 7 of the Endangered Species Act and the Magnuson-Stevens Act, supplemental NEPA documentation, as appropriate, and Section 401 Clean Water Act certification, and site-specific real estate plans. Erosion sites would be identified using engineering criteria with the consideration of consequences for previously identified economically justified basins. Repairs would be implemented following site-specific engineering design in accordance with the order established during the site selection process, subject to real estate acquisition by the State of California and with Federal cost-sharing.
- The non-federal sponsors may choose to construct erosion protection features within the sub-basins that are not economically justified on sites that have been identified based on engineering factors. Erosion sites should be implemented in the order determined by the engineering site ranking within the Site Selection and Implementation Process, subject to real estate acquisition constraints, following site-specific environmental compliance documentation and engineering design. Any work the non-federal partners decide to complete that is not selected through the full Site Selection and Implementation Process (e.g., is not within the current or future economically justified sub-basins), will not be eligible for SRBPP Federal funding and, unless considered to be routine maintenance, will need to be permitted under Section 408.
- Continue to refine the definition of sub-basins through further analysis of the hydrologic/hydraulic connectivity between sub-basins within the flood control system. On that basis, update the economic analysis for the SRBPP to potentially identify additional economically justified sub-basins, if appropriate.